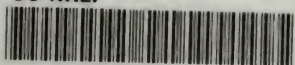


UC-NRLF



B 4 306 898

LIBRARY
UNIVERSITY OF
CALIFORNIA
SANTA CRUZ



SANTA CRUZ



UNIVERSITY OF CALIFORNIA

Gift of
MRS. ALVIN SEALE

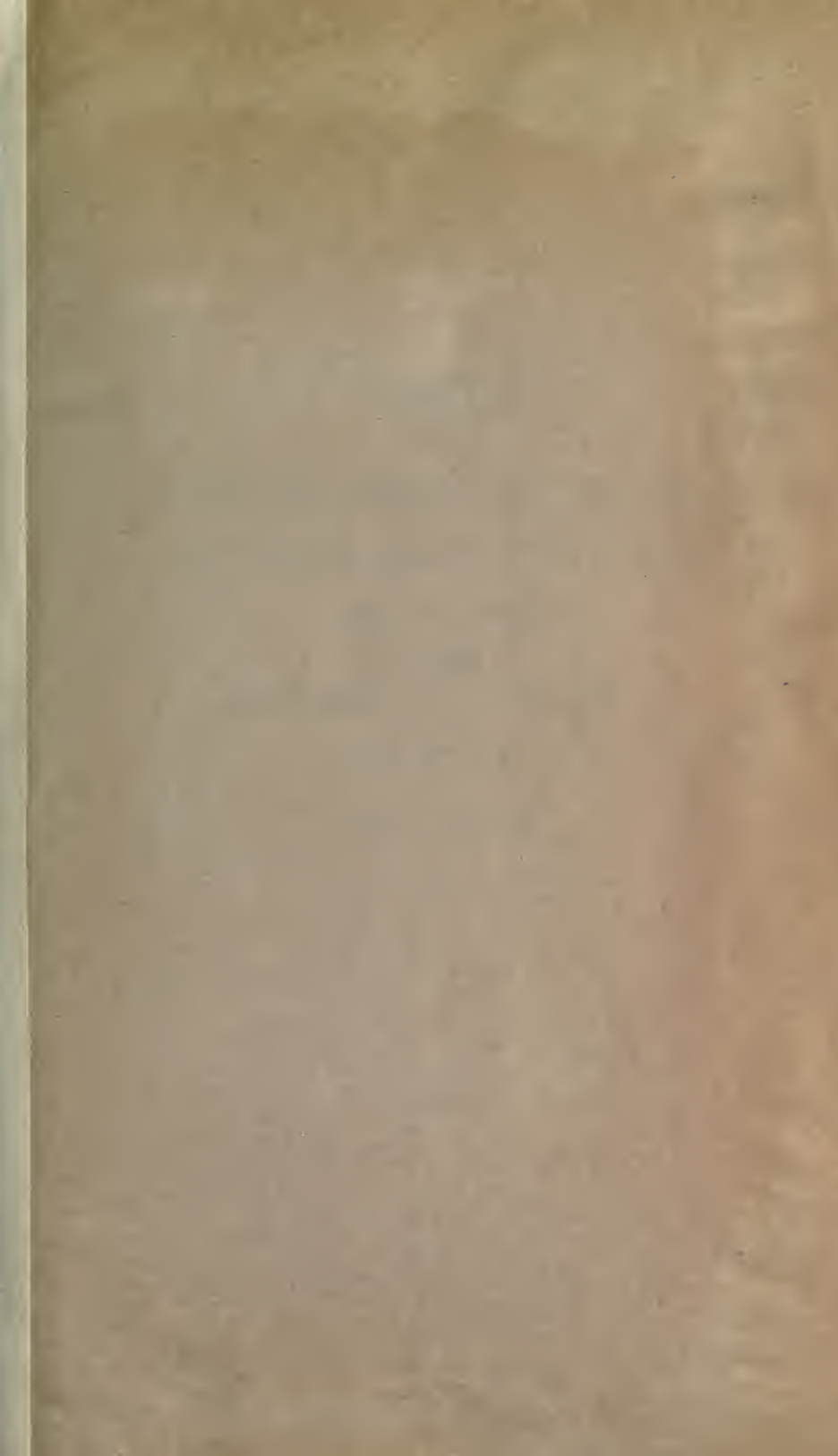


THE UNIVERSITY LIBRARY



SANTA CRUZ





BIRDS

A MISCELLANEOUS COLLECTION
OF THIRTY-SEVEN PAMPHLETS
ABOUT BIRDS

COLLECTED AND PRIVATELY
BOUND BY
ALVIN SEALE

1914



TABLE OF CONTENTS.

- QL
672
54
- A-BEAL- Food of the woodpeckers of the United States.
- B-HENSHAW- Does it pay the farmer to protect birds?
- C-McATEE-Index to papers relating to the food of birds.
- D- KALMBACH- Birds in relation to the alfalfa weevil.
- E- McATEE- Birds enemies of the codling moth.
- F-By U.S. Dept. of Agr.--English sparrow as a Pest.
- G-McATEE-Vanishing shorebirds.
- H-COOKE- Distribution and Migration of North American Herons and their allies.
- I-McATEE-Some common Game, Aquatic, and Rapacious Birds in relation to man.
- J-McATEE-Five important wild-Duck foods.
- K-HENSHAW-Our mid-Pacific Bird reservation.
- L-DILL-Report on conditions on the Hawaiian Bird reservation with list of the birds found on Laysan.
- M-BRYAN-Report on conditions on Laysan, with recommendations for protecting the Hawaiian Islands reservation.
- N-COOKE-Distribution of the American Egrets.
- O-DEARBORN-Bird houses and how to build them.
- P-COOKE- The migratory movements of birds in relation to the weather.
- Q-McATEE- Plants useful to attract birds and protects fruit.
- R-OBERHOLSER-Description of a new melospiza from California.
- S-RILEY- Descriptions of three new birds from Canada.
- SAFLEMING-A new teal from the Andaman Islands.
- T-MEARNs- Description of a new subspecies of the painted bunting from the Interior.
- U-BANGS- A new swift from palestine.
- V-GRINNELL-A new blue grosbeak from California.
- W-BANGS----Descriptions of new American birds.
- X-BARBOUR--Notes on some birds from the Island of Grenada.
- Y-RILEY---Description of a new Dryonastes from China.



RECEIVED

PAID TO THE ORDER OF THE
TREASURY DEPARTMENT
FOR THE PAYMENT OF
THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

THE DEBT OF THE
UNITED STATES

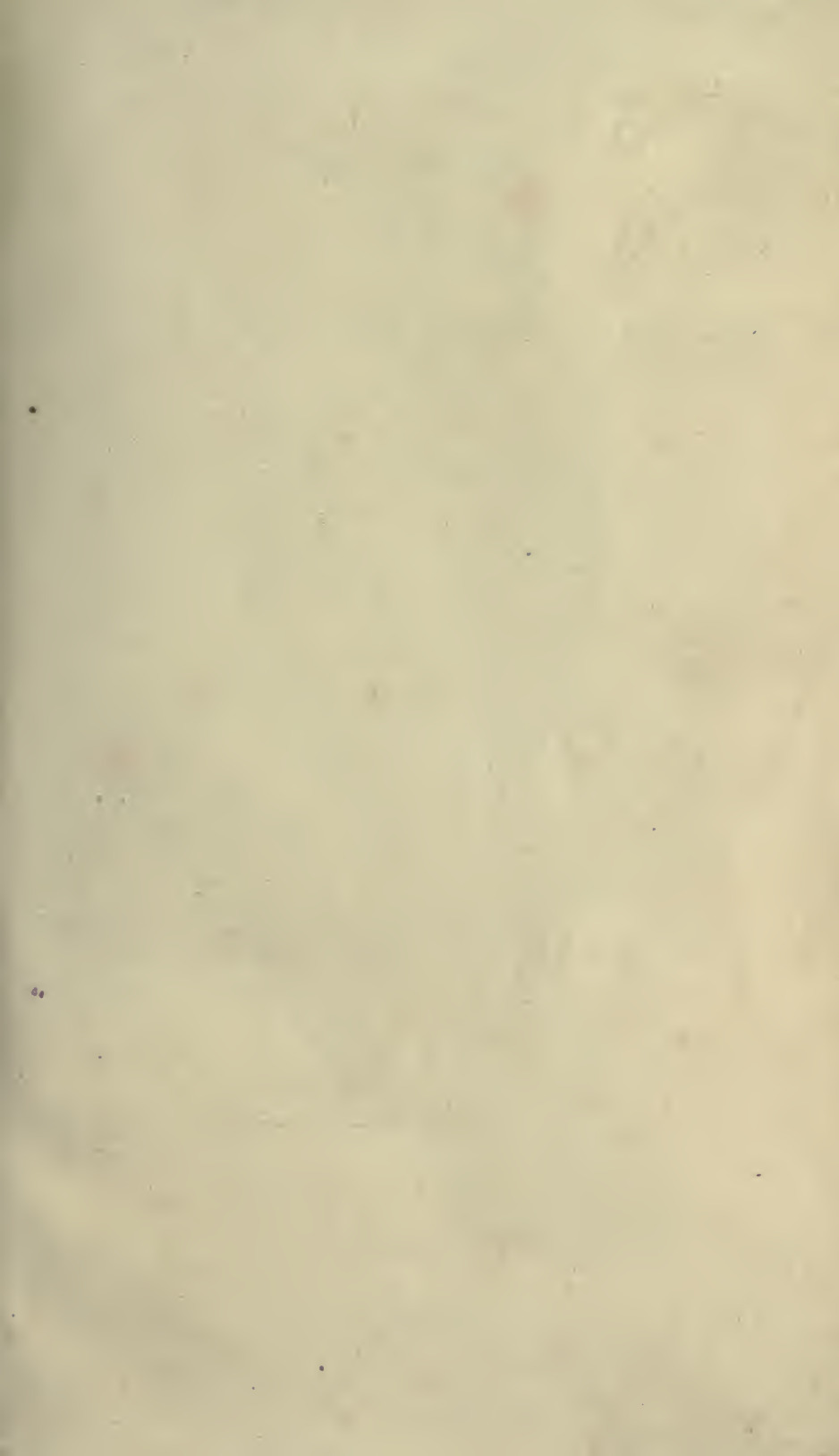
TABLE OF CONTENTS.

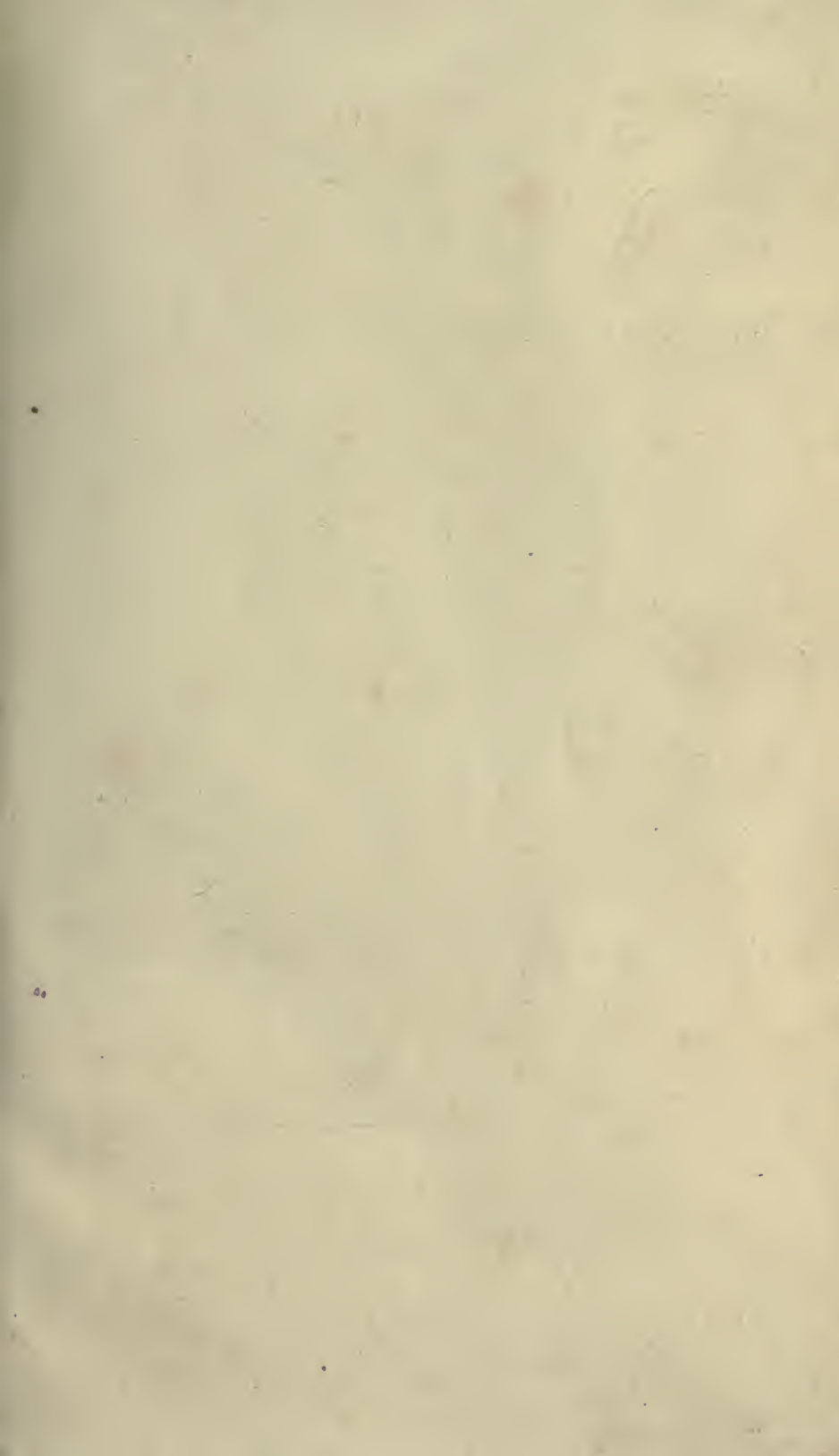
- Z-BANGE--A new Fantail from the Chatham Islands.
- AA-RIDGWAY-Diagnoses of some new forms of
 picidae.
- BB-BANGS---Two new birds from the Island of
 Molokai.
- CC-BANGS---A new bell-bird from Auckland Island.
- DD-BANGS---Two new woodpeckers from the Isle of
 Pines, West Indies.
- EE-RILEY---On the name and synonymy of the
 Antillean sharp-shinned Hawk.
- FF-BANGS---New or rare birds from Western Colombia
- GG-BANGS---Unrecorded specimens of two rare
 Hawaiian birds.
- HH-MUIR and ~~K~~ERSHAW-A new bird from the Island of
 Ceram, Moluccas.
- II-MUIR and KERSHAW-A new bird from the Island of
 Ceram, Mulloccas.
- JJ-RIDGWAY--Diagnoses of new forms of Micropodidae
 and Trochilidae.

Digitized by the Internet Archive
in 2007 with funding from
Microsoft Corporation

Seale, ALVIN comp

Buds; a miscellaneous
collection of pamphlets,
1914.







BREUKER & NESSLER CO LITH PHILA.

HAIRY AND DOWNY WOODPECKERS.

Issued May 24, 1911.

U. S. DEPARTMENT OF AGRICULTURE
BIOLOGICAL SURVEY—BULLETIN No. 37

HENRY W. HENSHAW, *Chief*

A

FOOD OF THE WOODPECKERS OF THE
UNITED STATES

BY

F. E. L. BEAL

Assistant, Biological Survey



WASHINGTON
GOVERNMENT PRINTING OFFICE
1911



9
A. Baker

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BIOLOGICAL SURVEY,
Washington, D. C., December 23, 1910.

SIR: I have the honor to transmit herewith for publication as Bulletin No. 37 of the Biological Survey, a report on the Food of the Woodpeckers of the United States, by F. E. L. Beal, assistant, Biological Survey. The diminished supply of timber and its greatly increased cost render the conservation of our remaining forests exceedingly important. It has been estimated that within the United States insects destroy trees and lumber to the value of upward of \$100,000,000 annually. As boring insects are the natural enemies of trees, so birds are their natural allies. Of all birds that further the welfare of the forest, woodpeckers are the most important, many of them indeed being specially adapted to dig into wood in order to reach insect larvæ safe from all other enemies. While most woodpeckers are thus highly beneficial, the sapsuckers are injurious, since they subsist to a considerable extent on the cambium or inner bark of trees. This bulletin is meant to serve a practical end by describing the food habits of the several species, and by pointing out the extent to which each is beneficial or injurious, so that the forester, the farmer, and the orchardist may know friend from foe.

Respectfully,

H. W. HENSHAW,
Chief, Biological Survey.

Hon. JAMES WILSON,
Secretary of Agriculture.



CONTENTS.

	Page.
Introduction.....	7
Hairy woodpecker.....	13
Downy woodpecker.....	17
Red-cockaded woodpecker.....	22
Nuttall woodpecker.....	23
Three-toed woodpeckers.....	25
Yellow-bellied woodpecker or sapsucker.....	27
Red-breasted sapsucker.....	31
Williamson sapsucker.....	32
Pileated woodpecker.....	33
Red-headed woodpecker.....	35
California woodpecker.....	43
Lewis woodpecker.....	45
Red-bellied woodpecker.....	47
Flicker.....	52
Red-shafted flicker.....	59
Ivory-billed woodpecker.....	62
Other woodpeckers.....	63

ILLUSTRATIONS.

PLATES.

	Page.
PLATE I. Hairy and downy woodpeckers.....	Frontispiece.
II. Yellow-bellied sapsucker.....	32
III. Red-headed woodpecker.....	32
IV. California woodpecker.....	40
V. Lewis woodpecker.....	40
VI. Flicker.....	48

TEXT FIGURES.

FIG. 1. Tongues of woodpeckers.....	8
2. Special development of tongues of woodpeckers.....	8
3. Wood from which woodpecker has extracted insect.....	9

FOOD OF WOODPECKERS.

(Picidæ.)

INTRODUCTION.

During the last few decades much interest has been aroused in the preservation and extension of forest areas within the United States, and large sums of money have been spent on our National Forests. Meanwhile scientists have been studying means to combat the insect enemies of forests, which in some cases have threatened the total destruction of large tracts. There is probably no species of land plant that has not at least one insect enemy, and the trees of the forest furnish food and homes for legions. In the Fifth Report of the United States Entomological Commission over 400 species of insects are reported to feed on the oak, and the opinion is expressed that this number is far below the total. In the same work about 80 species are said to feed on the elm, 170 on the hickory, 41 on the locust, 100 on the maple, 105 on the birch, 186 on the willow, and 165 on the pine; and in each case the list is confessedly incomplete.

On this point Dr. Hopkins has said:

The results of investigation lead to the conclusion that the annual loss from insect work on forest trees, and their crude or finished products, amounts to at least \$100,000,000.

No period in the life history of a tree is exempt from insect attack, and every part, from the smallest roots to the terminal buds, leaves, flowers, and fruit, may be infested by one or many species. The seed in the ground, the tender shoots of both roots and stems, and the young seedling to the matured tree, may be attacked by special enemies which injure or destroy different parts of the entire plant. In fact, living, diseased, dead, or decaying, a tree may be the home of hundreds of species and thousands of individuals of insect life.¹

Wherever the *Dendroctonus* beetles have been found in standing timber, the work of woodpeckers has been more or less common, and in some trees quite a large percentage of the beetle broods has been destroyed by the birds. The evidence gathered in Maine a few years ago indicates quite conclusively that the birds were rendering a most valuable service as a natural check to the multiplication and destructive work of the eastern spruce beetle. The work of birds is common in sections where species 1 [*Dendroctonus brevicomis*], 9 [*D. monticolæ*], and 10 [*D. ponderosæ*], and other western species are prevalent. Yet birds evidently render the greatest service where but few trees are being killed, since their concentrated work may prevent an abnormal increase of the beetles; but where many hundreds or thousands of trees are being killed, the limited number of birds can have little or no effect. Therefore, while the birds are among the foresters' valuable friends, they can not, even with the utmost protection, always be relied upon to protect the forest from its enemies.²

¹ From manuscript of lecture on Forest Insects and Their Destructive Work, by Dr. A. D. Hopkins, in charge of Forest Insect Investigations, Bureau of Entomology, U. S. Dept. Agric.

² Hopkins, A. D., Bull. 83, Bureau of Entomology, U. S. Dept. Agric., Part I, pp. 27-28, 1909.

From these considerations it is at once apparent how important must be any agency that restrains or limits this great army of tree destroyers. Of all birds that further the welfare of trees, whether of forest or orchard, woodpeckers are the most important. The value of their work in dollars and cents is impossible to calculate, but careful study of their food in both field and laboratory has brought out many facts of practical importance.

Woodpeckers are essentially arboreal in their habits and obtain the greater part of their food from trees. Their physical conformation eminently adapts them to this mode of life. Their legs are rather short and stout, and the toes are furnished with strong, sharp claws. With the exception of the genus *Picoides*, all North American woodpeckers have four toes, two of which point forward and two backward. To further aid in maintaining themselves on the trunks of trees, their tails are composed of stiff feathers terminating in sharp spines, which can be pressed against the

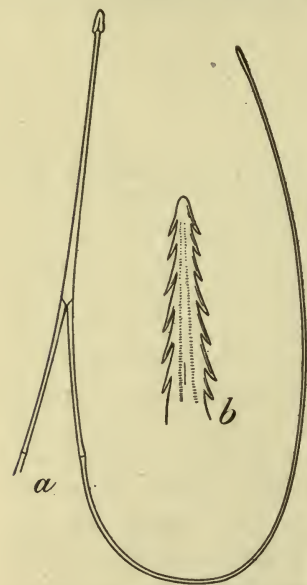


FIG. 1.—Tongues of woodpeckers.

bark and so serve as a prop to hold the bird in an upright position while it is at work. Woodpeckers are thus enabled to cling easily to the trunks and branches and to strike effective blows with their beaks upon the bark or wood.

As much of the food of woodpeckers is obtained from solid wood, Nature has provided most of them with a stout beak having a chisel-shaped point, which forms an exceedingly effective wood-cutting instrument. But the most peculiar and interesting point in the anatomy of these birds is the tongue. This is more or less cylindrical in form and usually very long (fig. 1, *a*). At the anterior end it generally terminates in a hard point, with more or less barbs upon the sides (fig. 1, *b*). Posteriorly the typical woodpecker tongue is

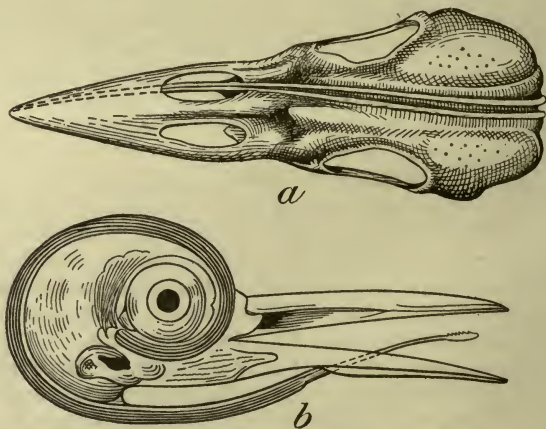


FIG. 2.—Special development of tongues of woodpeckers.

extended in two long, slender filaments of the hyoid bone which curl up around the back of the skull and, while they commonly stop between the eyes, in some species they pass around the eye (fig. 2, *b*), but in others enter the right nasal opening and extend to the end of the beak (fig. 2, *a*). In this last case the tongue is practically twice the length of the head. Posteriorly this organ is inclosed in a muscular sheath by means of which it can be extruded from the mouth to a considerable length, and used as a most effective instrument for dislodging grubs or ants from their burrows in wood or bark. Hence, while most birds have to be content with such insects as they find on the surface or in open crevices, the woodpeckers devote their energies to those larvæ or grubs which are beneath the bark or even in the heart of the tree. They locate their hidden prey with great accuracy and often cut small holes directly to the burrows of the grubs. In



FIG. 3.—Wood from which woodpecker has extracted insect.

figure 3 the grub had eaten a burrow through the heart of a maple sapling, but its position was accurately determined by the bird, which then cut through the solid live wood until it reached the burrow and extracted the insect.

In the United States, exclusive of outlying possessions, there are about 45 species and subspecies of this family, most of which are of decided economic importance. As a family they are much less migratory than most other birds, and a majority of the species occupy the same range throughout the year, which adds materially to their value to farmers. Their food consists so largely of wood-boring grubs, hibernating insects, and insects' eggs and pupæ that their supplies do not fail even in the coldest weather.

The present paper is based upon the examination of 3,453 stomachs of woodpeckers representing 16 species and nearly twice as many subspecies, taken in all parts of the United States, with a few from Canada. In the following table the species are arranged in the

order of the average amount of animal food contained in their stomachs.

Name of species.	Number of stomachs.	Per cent of animal food.	Per cent of vegetable food.
Three-toed woodpecker (<i>Picoides americanus</i>).....	23	94.06	5.94
Arctic three-toed woodpecker (<i>Picoides arcticus</i>).....	28	88.69	11.31
Williamson sapsucker (<i>Sphyrapicus thyroideus</i>).....	17	86.67	13.33
Red-cockaded woodpecker (<i>Dryobates borealis</i>).....	76	81.06	18.94
Nuttall woodpecker (<i>Dryobates nuttalli</i>).....	53	79.41	20.59
Hairy woodpecker (<i>Dryobates villosus</i>).....	382	77.67	22.33
Downy woodpecker (<i>Dryobates pubescens</i>).....	723	76.05	23.95
Pileated woodpecker (<i>Phloeotomus pileatus</i>).....	80	72.88	27.12
Red-breasted sapsucker (<i>Sphyrapicus ruber</i>).....	34	68.92	31.08
Red-shafted flicker (<i>Colaptes cafer</i>).....	183	67.74	32.26
Flicker (<i>Colaptes auratus</i>).....	684	60.92	39.08
Yellow-bellied sapsucker (<i>Sphyrapicus varius</i>).....	313	49.31	50.69
Lewis woodpecker (<i>Asyndesmus lewisi</i>).....	59	37.48	62.52
Red-headed woodpecker (<i>Melanerpes erythrocephalus</i>).....	443	33.83	66.17
Red-bellied woodpecker (<i>Centurus carolinus</i>).....	271	30.94	69.06
California woodpecker (<i>Melanerpes f. bairdi</i>).....	84	22.59	77.41
Total.....	3,453		
Average.....		64.26	35.74

It is not probable that these relations are absolute in every case. The position of *Sphyrapicus ruber* above the two species of *Colaptes* is perhaps accidental, and the examination of a few stomachs more or less would be likely to change slightly the relative positions. The vegetable food, of course, stands in an inverse ratio to the animal. Mineral matter (sand) is not taken largely by woodpeckers. The most is found in the stomachs of the flickers, but it is probably picked up accidentally with ants, of which these birds eat great numbers. Ants constitute the largest item of animal food—28.41 per cent, considering the whole 16 species collectively—and are actually the largest item in the stomachs of 8 species. The Williamson sapsucker, the red-cockaded woodpecker, and the two flickers take the highest rank in this respect. Beetles stand next in importance, and amount to 20.42 per cent. These two items together form nearly half the food. The remainder of the animal food is composed of insects, with a few spiders, millepeds, and sowbugs, and occasionally a salamander, tree frog, lizard, or snail. In the following table is given the average percentage of ants and beetles in the stomach. The species are arranged in the order of their rank as ant eaters.

Name of species.	Per cent of ants.	Per cent of beetles.
Williamson sapsucker (<i>Sphyrapicus thyroideus</i>).....	85.94	0.13
Red-cockaded woodpecker (<i>Dryobates borealis</i>).....	56.75	11.02
Red-shafted flicker (<i>Colaptes cafer</i>).....	53.82	6.55
Flicker (<i>Colaptes auratus</i>).....	49.75	5.14
Red-breasted sapsucker (<i>Sphyrapicus ruber</i>).....	42.49	4.02
Pileated woodpecker (<i>Phloeotomus pileatus</i>).....	39.91	22.01
Yellow-bellied sapsucker (<i>Sphyrapicus varius</i>).....	34.31	6.02
Downy woodpecker (<i>Dryobates pubescens</i>).....	21.36	21.55
Hairy woodpecker (<i>Dryobates villosus</i>).....	17.10	41.42
Lewis woodpecker (<i>Asyndesmus lewisi</i>).....	11.87	9.12
Three-toed woodpecker (<i>Picoides americanus</i>).....	8.29	71.05
Nuttall woodpecker (<i>Dryobates nuttalli</i>).....	8.19	28.86
California woodpecker (<i>Melanerpes f. bairdi</i>).....	8.09	2.67
Red-bellied woodpecker (<i>Centurus carolinus</i>).....	6.45	10.18
Arctic three-toed woodpecker (<i>Picoides arcticus</i>).....	6.35	67.66
Red-headed woodpecker (<i>Melanerpes erythrocephalus</i>).....	5.17	18.85
Average.....	28.49	20.39

If the 16 species of woodpeckers herein discussed were arranged in the order of their usefulness according to their food, they would stand about as at top of page 10, except that the 3 species of *Sphyrapicus*, owing to their sap-sucking propensities, might be placed at the foot of the column. It is unfortunate that so few stomachs of the three or four species nearest the top have been received, but probably those examined were in no way exceptional. The 2 species of *Picoides* are among the most useful birds, especially in the forest, of which they are preeminently the conservators. More than 60 per cent of the animal food of these two birds consists of the larvæ of wood-boring beetles, which they dig from the bark and wood of trees. The two species *Dryobates pubescens* and *D. villosus* do not fall far behind in this good work, and several others eat very appreciable quantities of wood borers. Among the beetles eaten by the different birds are naturally some useful species, such as the predaceous ground beetles (Carabidæ) or tiger beetles (Cicindelidæ). The redhead eats useful beetles to the extent of 7.34 per cent of its diet, the Lewis woodpecker, with 6.7 per cent, stands next on the list of offenders in this respect, followed by the red-shafted flicker with 3.9 per cent, and the eastern flicker with less than 2 per cent. No other species had eaten so much as 1 per cent of these beetles. Whatever sins woodpeckers may commit, the destruction of useful beetles is not one of them.

Nearly all the vegetable food, except a few seeds, including some grain, can be included under three items—fruit, cambium, and mast. The greatest interest attaches to the cambium, which is a jellylike substance found just under the bark of growing trees and from which both wood and bark are formed. The smaller species of woodpeckers have been accused of pecking the bark from fruit and forest trees to an injurious extent in order to get this substance. While nearly all members of the family eat some cambium, the only ones that really do much harm by the habit appear to be the yellow-bellied sapsucker (*Sphyrapicus varius*) and others of the same genus. With the yellow-bellied sapsucker cambium amounts to about 17 per cent of the annual food and in April reaches 48 per cent. As the substance is often semifluid, probably much passes almost immediately out of the stomach, leaving only the harder and less easily digested part, so that a much larger amount is eaten than is shown by stomach examination.

In obtaining the cambium the bird sometimes denudes the tree of its bark over a considerable area, and so ruins it for any economic use except fuel; at other times a series of single punctures are made in lines extending around the tree, and as new layers of wood grow over these, the indentation at each puncture becomes less and less pronounced. If, after some years, this timber be cut and sawed,

a tangential or circular cut across the punctures gives a bird's-eye appearance very similar to that which Nature produces in some maples. A radial cut through the punctures gives the curly look often found in many woods. It frequently happens, however, that water enters at the punctures and causes a slight decay, which usually disfigures the wood by making a dark stain, though occasionally the effect is ornamental.

With the possible exception of the crow, no birds have been subject to so much adverse criticism as the woodpeckers. When they are seen scrambling over fruit trees and fresh holes are found in the bark, it is concluded that they must be doing harm. But woodpeckers, except a few species, rarely disfigure a healthy tree, but when they find a tree infested by wood-boring larvæ, they locate the insects accurately, draw them out, and devour them. If in succeeding years the burrows formerly occupied by the larvæ are used by a colony of ants, they in turn are dug out and destroyed.

The following are samples of testimony by Dr. Hopkins and other eminent entomologists to the persistent and effective work of woodpeckers in destroying wood-boring beetles and other insect enemies of trees:

As has already been stated, woodpeckers are the most important enemies of the bark beetle, and appear to be of inestimable value to the spruce-timber interests of the Northeast. Indeed, I feel confident that in the many hundreds of infested trees examined at least one-half of the beetles and their young had been destroyed by the birds, and in many cases it was evident that even a greater proportion had perished from this cause alone.

Estimating 100 beetles to the square foot of bark in the average infested tree, and an average of 60 square feet of infested bark, it is possible for each tree to yield an average of 6,000 individuals; 100 trees, 600,000, and so on. It is therefore plain that, if one-half or two-thirds of this number are destroyed by the birds and other enemies, the amount of timber the remainder can kill will be lessened. This is all the more apparent when it is remembered that it is only when the beetles occur in great numbers that they can overcome the resistance of the living trees.¹

Birds contribute their share, also, in destroying larvæ and pupæ. The work of woodpeckers was found upon most of the trees which had been killed by *Dendroctonus brevicomis*, and these birds had evidently destroyed a large percentage of the insects in some of the trees.²

As natural enemies of this insect [the maple borer, *Plagionotus speciosus*] it is probable that various species of woodpeckers render the greatest service. At Huntington, Mass., I have seen the hairy woodpecker, the downy woodpecker, and the flicker feeding upon white larvæ taken from beneath the bark of maples infested by this borer.³

Woodpeckers do much good by hammering holes in the bark of infested cottonwoods and devouring the young carpenter worms [larvæ of *Cossus populi*]. We certainly ought to protect these feathered friends of ours instead of allowing every small boy in the country to shoot them whenever he pleases.⁴

¹ Hopkins, A. D., Bull. 28 (new ser.), Division of Entomology, U. S. Dept. Agric., pp. 23, 25-26, 1901.

² Webb, J. L., Bull. 58, Part II, Bureau of Entomology, U. S. Dept. Agric., p. 27, 1906.

³ Kirkland, A. H., in Mass. Crop Report for June, 1897, p. 32, 1897.

⁴ Doten, S. B., Bull. 49, Nevada Agric. Exper. Sta., p. 12, 1900.

I have found no parasite of this larva [*Hepialus argenteomaculatus*], but I have seen that the woodpeckers are its deadly foes. In April, 1886, I had a favorable opportunity to search for the borer and was astonished at the scores removed by these birds. They often drill through a deep layer of wood; often two holes are made one above the other, the purpose being obvious. The morsel is evidently located, or its burrow rather, by sounding, as I noticed many instances in which a row of punctures surrounded the base of the alder. The destroyers are sometimes mistaken, for I found their drillings, evidently made in search of this larva, in sound wood in which there were no borers, but these were few compared with the successful trials.

Is it the activity of these birds that prevents the abundance in the forests of certain borers, e. g. *Aegeria aceris*, whilst the same insect is often destructively abundant in the ornamental maples of cities and villages? ¹

HAIRY WOODPECKER.

(*Dryobates villosus* subsp.)

The hairy woodpecker (frontispiece), in one or another of its various forms, inhabits the whole of temperate North America, but is rare over some extensive areas. It is a rather restless, noisy bird, as compared with its smaller relative, the downy, and makes itself conspicuous by loud calls and rapid flights from tree to tree. It is eminently arboreal in its habits and gets most of its food from trees. While sometimes found in the midst of a dense forest, it prefers the outer edge of the woodland or groves or orchards. In the latter it is quite at home, especially if the trees be old and neglected, for then they usually offer decayed knots and limbs where wood borers establish their colonies. The bird is not migratory, unless within very narrow limits, and where it occurs at all can usually be found the year round. It nests in a cavity which it excavates in a partly decayed trunk or branch. While often seen in the orchard, the hairy does not go there for fruit. More than three-fourths of its food consists of animal matter, and less than a fourth of the remainder is fruit, mostly of wild species.

In the investigation of the food of the hairy woodpecker detailed below, 382 stomachs were examined. They were obtained from 33 States and Territories, the District of Columbia, and Canada, and were taken in every month of the year. They undoubtedly embrace all the recognized subspecies, but as some of them were collected before all the forms had been defined, they can not now be distinguished. However, as the food of the various subspecies does not differ materially, the species has been treated as a whole. In the first analysis the food divides into 77.67 per cent of animal matter and 22.33 of vegetable. The animal food consists of insects, with a few spiders and millepeds; the vegetable part is made up of fruit, seeds, and a number of miscellaneous substances. This ratio of animal to vegetable does not vary greatly during the year, the greatest difference

¹ Kellicott, D. S., *Insect Life*, I, 251, Feb., 1889.

occurring in June, when the stomachs show 90 per cent of animal to 10 per cent of vegetable food. There is, however, no regular increase or decrease as the seasons change, such as is noted in birds that subsist upon flying insects and summer fruits. The wood-boring larvæ upon which this bird so largely feeds can be obtained at all times of the year, and the same is true of most of the vegetable food.

Animal food.—The largest item in the annual diet of the hairy woodpecker consists of the larvæ of cerambycid and buprestid beetles, with a few lucanids and perhaps some other wood borers. These insects constitute over 31 per cent of the food and are eaten in every month of the year. The greatest amount is taken in December, when it reaches 41 per cent of the whole; and in May, the month of least consumption, it still amounts to over 21 per cent. This shows how earnest these birds are in their efforts to procure this kind of food. In summer, insects and small fruits abound—enough to satisfy appetite and in variety apparently suited to every taste—but the birds still search for and obtain these wood-boring grubs to the extent of a fifth or more of their daily food, at the cost of hours of hard labor in digging them from the tree. One stomach contained 100 of these larvæ and 83 and 50, respectively, were taken from two others. Of the 382 stomachs, 204, or 53 per cent, contained these grubs, and 27 of them held no other food. Other beetles amount to a little more than 9 per cent. They are distributed among a number of families, but are nearly all more or less harmful.

Weevils (*Rhynchophora*), or snout beetles, aggregate a little more than 3 per cent, and are mostly represented by the curculios (*Curculionidæ*) and engraver beetles (*Scolytidæ*). One of the former, *Dorytomus mucidus*, seems to be a favorite, as it was found in a number of stomachs, of which one contained 109 and another 63 individuals. The engravers were found in 18 stomachs. One contained 50 adults and 25 larvæ; another, 21 adults and 10 larvæ. They were of such species as *Tomicus cælatus* and *Polygraphus rufipennis*. Of the latter, 17 individuals were taken from one stomach. A few carabids, or predaceous ground beetles, were also found. The average amount of these useful insects consumed is sixty one-hundredths of 1 per cent (0.60). The month of greatest consumption is March, when they are eaten to the extent of 2.46 per cent of the whole food. Evidently this bird does little harm by eating useful beetles.

Ants stand second in importance in the diet of the hairy woodpecker. They amount to a little more than 17 per cent, and are eaten in every month. In January, which is the month of greatest consumption, they reach more than 27 per cent and nearly the same in February. They are apparently eaten the least in November, when they aggregate somewhat more than 10 per cent, but this may be accidental, as both October and December show higher percentages and July practically the same. In a general way these insects

are eaten most in winter and early spring, but every month has a good percentage. Hymenoptera other than ants are taken very irregularly and in small quantities. In September somewhat more than 5 per cent were eaten, but stomachs taken in May and December contained none at all, and the average for the year is but a little more than 1 per cent. In one stomach were found sawfly larvæ, insects which do not appear to be eaten extensively by birds.

Caterpillars are the next most important item of the hairy's food. They amount to a little less than 10 per cent, and were found in every month. The greater number were taken in August, when they aggregated nearly .19 per cent, while March showed the least, a little less than 2 per cent. Many of them were wood-boring species dug out from the wood, like the beetle larvæ. Prof. F. M. Webster states that he has seen a hairy woodpecker successfully peck a hole through the parchment-like covering of the cocoon of a *Cecropia* moth and devour the contents. On examining more than 20 cocoons in a grove of box elders, he found only 2 uninjured.

Bugs (Hemiptera) are evidently not a favorite food, as they were found only to the extent of 2.41 per cent for the year. June appears to be the month of greatest consumption, with somewhat less than 8 per cent, but four months show none at all, and bugs are very irregularly distributed through the rest of the year. Plant-lice (aphids) were found in 2 stomachs and scales in 4. One of the latter was identified as the cherry or plum scale (*Eulecanium cerasifex*). Orthoptera, that is, grasshoppers, crickets, and cockroaches, are rarely eaten by the hairy. A few eggs, probably those of tree crickets, and the egg cases (oötheca) of cockroaches, constitute the bulk of this food. These with a few miscellaneous insects amount to a little more than 2 per cent for the year. Spiders with their cocoons of eggs, including one jointed spider (Solpugidæ), and a few millepeds, were eaten to the extent of about 3.5 per cent, which completes the quota of animal food.

The following is a list of insects identified in the food of the hairy woodpecker:

COLEOPTERA.

Agonoderus pallipes.
Ips fasciatus.
Melanotus cribricollis.
Chrysobothris sp.
Cymatodera undulata.
Lachnosterna sp
Ergates sp.
Asemum mæstum.
Eleodes sp.

Nyctobates pennsylvanica.
Upis ceramboides.
Boletotherus bifurcus.
Boletophagus corticola.
Dendroides sp.
Dorytomus mucidus.
Tomicus cælatus.
Polygraphus rufipennis.

HYMENOPTERA.

Ant (*Camponotus pictus*).

DIPTERA.

Bluebottle fly (*Phormia* sp.).

HEMIPTERA.

Plum and cherry scale (*Eulecanium cera-* Harvest fly (*Tibicen rimosa*).
sifex).

Vegetable food.—The vegetable food of the hairy woodpecker may be considered under four heads: Fruit, grain, seeds, and miscellaneous vegetable substances. Fruit amounts to 5.22 per cent of the food, and was contained in 54 stomachs, of which 13 held what was diagnosed as domestic varieties, and 41 contained wild species. Rubus seeds (blackberries or raspberries) were identified in 4 stomachs, and were counted as domestic fruit, but it is perhaps more probable that they were wild. Strawberry seeds (occurring in 1 stomach) and pulp (thought to be apple) were the only other cultivated varieties that could be distinguished with a reasonable degree of certainty. Evidently the hairy woodpecker does no damage by preying upon orchard or garden products. Of wild fruit 18 species were identified. It constitutes the great bulk of the fruit eaten, and is nearly all of varieties not useful to man.

Corn was the only grain discovered in the food. It was found in 10 stomachs, and amounted to 1.37 per cent. In 2 stomachs taken in August and September it was still in the milk, but all the rest was eaten in winter, so it must have been waste. Seeds of various plants had been eaten by 18 birds, but most of them were of little economic value. The seed of poison ivy and poison sumac (*Rhus radicans* and *R. vernix*) were found in 17 stomachs, and as they usually pass through the alimentary canal uninjured, the birds do some harm by scattering the seeds of these noxious plants. The total percentage of seeds of all kinds is 4.50.

Cambium, or the inner bark of trees, was identified in 23 stomachs. Evidently the hairy does but little damage by denuding trees of their bark. Mast, made up of acorns, hazelnuts, and beechnuts, was found in 50 stomachs. It was mostly taken in the fall and winter months, and appears to be quite a favorite food during the cooler part of the year. Dr. Merriam says that in northern New York the hairy woodpecker, like the other woodpeckers of the Adirondack region, feeds largely on beechnuts. In late fall, winter, and early spring following good yields of beechnuts, the nuts form the principal food of the woodpeckers. When grubs and ants are taken from decayed or decaying trees, bits of rotten wood, dead leaves, and other rubbish are eaten with them. Such material was found in 72 stomachs, though in most cases the percentage was small. Cambium, mast, and rubbish together constitute a little less than 11 per cent of the food.

The following is the list of fruits and seeds identified in the food:

Foxtail grass (<i>Itophorus</i> sp.).	Juneberry (<i>Amelanchier canadensis</i>).
Bayberry seed (<i>Myrica carolinensis</i>).	Northwestern Juneberry (<i>Amelanchier alnifolia</i>).
Hazelnut (<i>Corylus</i> sp.).	Chokeberry (<i>Aronia</i> sp.).
Beechnut (<i>Fagus americanus</i>).	Strawberry (<i>Fragaria</i> sp.).
Acorn (<i>Quercus</i> sp.).	Chokecherry (<i>Prunus virginiana</i>).
Mulberry (<i>Morus rubra</i>).	Black or rum cherry (<i>Prunus serotina</i>).
Sassafras berry (<i>Sassafras sassafras</i>).	Woodbine berry (<i>Parthenocissus quinquefolia</i>).
Spice berry (<i>Benzoin benzoin</i>).	Frost grape (<i>Vitis cordifolia</i>).
Pigweed (<i>Amaranthus</i> sp.).	Sumac (<i>Rhus glabra</i>).
Pokeberry (<i>Phytolacca decandra</i>).	Poison sumac (<i>Rhus vernix</i>).
Vervain (<i>Verbena</i> sp.).	Poison ivy (<i>Rhus radicans</i>).
Blueberry (<i>Vaccinium</i> sp.).	Black mustard (<i>Brassica nigra</i>).
Elderberry (<i>Sambucus canadensis</i>).	Barberry (<i>Berberis</i> sp.).
Sour gum (<i>Nyssa sylvatica</i>).	Magnolia (<i>Magnolia foetida</i>).
Flowering dogwood (<i>Cornus florida</i>).	
Rough-leaved dogwood (<i>Cornus asperifolia</i>).	

Summary.—The foregoing analysis of the food of the hairy woodpecker shows that it is a bird from which the orchardist and forester have nothing to fear and much to gain. The quantity of useful insects or economic produce which it eats is insignificant. On the other hand, the number of destructive larvæ which it devours must have a very sensible effect in reducing the abundance of these pests.

DOWNY WOODPECKER.

(*Dryobates pubescens* subsp.)

The downy woodpecker (frontispiece) is the smallest member of the family in the United States. With its various forms it occupies practically the whole country and extends north into British America and as far as Alaska. To the ordinary observer it is but a miniature edition of the hairy, as the plumage is practically the same. It is also a quieter bird and probably the least wary and suspicious member of the family. When busy in search of food, it pays little attention to human intruders, and often the first intimation of its presence is a gentle tapping on a dead branch or knot only a few yards away, where a colony of ants or some wood-boring larvæ have established themselves.

Like the hairy, it does not migrate, and may be found on its range at any time during the year. Owing, perhaps, to the absence of so many other birds and the leafless condition of the trees, it seems to be most conspicuous in winter. After the summer visitors have gone southward, the downy has a habit of associating with a mixed company of titmice, creepers, nuthatches, and sometimes a few kinglets, who seem to be bound together by a community of interest in the

matter of food, for they all forage over the bark of the trunks and branches of trees and eat practically the same things.

The following are samples of testimony as to the good work of the downy:

The downy woodpecker, which is so common in Montana and which is so often seen in our orchards, is the fruit-grower's friend. Besides picking up miscellaneous pests it locates burrows of this borer [flat-headed apple-tree borer, *Chrysobothris femorata*] and extracts them in considerable numbers. In the older orchards of Montana scarcely a tree can be found that does not bear the marks of woodpeckers, a large proportion of which are made by this species.¹

Mr. E. Dwight Sanderson, in speaking of the work of the downy woodpecker, says:

He is the arch enemy of the codling moth and were it not for his good offices in destroying the larvæ in the winter your apple crop might frequently be a failure.²

Prof. Samuel Aughey examined four stomachs of the downy woodpecker in Nebraska, all of which contained grasshoppers.

The late Dr. Townend Glover, entomologist of the Department of Agriculture, states that the stomach of a downy woodpecker shot in February "was filled with black ants." He states further:

On one occasion a downy woodpecker was observed by myself making a number of small, rough-edged perforations in the bark of a young ash tree, and upon examining the tree when the bird had flown it was found that wherever the bark had been injured the young larvæ of a wood-eating beetle had been snugly coiled underneath, and had been destroyed by the bird.³

In the laboratory investigation of the food of the downy woodpecker 723 stomachs were examined. They were collected in 33 States, the District of Columbia, and Canada. They are quite regularly distributed over the 12 months of the year, and probably represent fairly the average annual food. This is made up of 76.05 per cent of animal matter to 23.95 per cent of vegetable.

Animal food.—Beetles taken collectively amount to 21.55 per cent, and are the largest item of the food. Of these, a little less than 14 per cent are wood-boring larvæ, principally cerambycids, with some buprestids. They were found in 289 stomachs, or about 40 per cent of all, and 10 contained no other food. This is only about half the amount found in the stomachs of the hairy woodpecker, and shows that the downy pecks wood much less than the hairy. These larvæ are eaten at all times of the year, though the most are taken in the cooler months. In November they constitute 20 per cent of the food, which is the maximum, though in the other fall months and in the winter and spring months they do not fall far below. In June the minimum of 4.5 per cent was eaten. The economic value of the destruction of these larvæ is very great.

¹ Cooley, R. A., Bull. 51, Montana Agric. Exper. Sta., p. 226, 1903.

² Bull. 131, New Hampshire Agric. Exper. Sta., p. 18, 1907.

³ U. S. Commissioner of Agric., Rept. for 1865, pp. 37-38, 1866.

Weevils amount to a little more than 3 per cent, but appear to be a rather favorite food, as they were found in 107 stomachs, and 4 contained 50, 36, 34, and 33 adult individuals, respectively, while in another were 100 in the pupal stage. The engravers (*Scolytidæ*) were identified in 12 stomachs. Other beetles aggregate a little less than 5 per cent of the food, and are all more or less harmful except a few carabids, which amount to 0.80 per cent for the year.

Ants are eaten by the downy to the extent of 21.36 per cent of its diet, and are taken more regularly than any other element of the food. October, with 9.85 per cent, appears to be the month of minimum consumption, but it is doubtful if this would always hold, as every other month shows at least twice this amount. Hymenoptera other than ants are eaten very sparingly by the downy. They aggregate only 1.18 per cent, and in June, the month of greatest consumption, amount to only 2.45 per cent, while none were found in the 28 stomachs taken in May.

Hemiptera, or bugs, were found in 111 stomachs, and constitute 8.57 per cent of the food. Scales, or bark lice, were found in 41 stomachs and aphids, or plant lice, in 20. A collection of 10 stomachs taken in Maine in March contained from 90 to 100 per cent of scales, the average for 10 stomachs being 93.10 per cent. This would seem to indicate that where these insects abound, the birds collect and feed upon them almost exclusively. Scales and plant lice together amount to 2.85 per cent of the yearly food. Four genera and two species of scales were identified. Bugs of various other species reach a little less than 6 per cent.

Caterpillars appear to be a very acceptable food for the downy woodpecker, as they constitute 16.50 per cent of the yearly diet. A large proportion of them are of the wood-boring species, and were evidently dug out of the wood, the same as the beetle larvæ. Others are surface feeders taken from leaves and bark. In this connection the greatest interest attaches to the pupæ and larvæ of the codling moth, generally recognized as the worst pest of the apple orchard. These insects, in one stage or the other, were identified in 8 stomachs. While this is a small number, the wonder is that the bird gets them at all. The eggs are minute, and as soon as they hatch the larvæ bore into the fruit, where they feed in security, though it is claimed by some observers that woodpeckers sometimes dig them out. When full grown, they leave the apple and crawl into some cranny, where they change to pupæ. It is in this condition, i. e., as larvæ full grown or pupæ, that they are secured by the birds. One stomach of the downy contained 18, and another 16 of these grubs. As the adult moth flies by night and lies hidden during the day, it is probably not often taken by birds. In any case, it would be hard to identify in the stomachs. Various insects, including grasshoppers and flies,

make up about 2 per cent of the food. Grasshoppers, though so acceptable to many birds, were found in only 2 stomachs of the downy. On the other hand, eggs of grasshoppers, crickets, katydids, and cockroaches were identified in 48 stomachs, mostly taken in the fall and winter. Eleven stomachs from Kansas collected in December deserve special notice. Eight of them contained the eggs of grasshoppers to an average extent of 10 per cent of all the contents. Seven stomachs taken in Illinois in March contained grasshoppers' eggs to an average of over 46 per cent of the whole food. This is evidence of valuable service and emphasizes the fact that this bird resorts to the ground for food in case of necessity.

Miscellaneous insects amount to but 2.80 per cent, but among them is one that deserves particular notice. This is the immature form of the dobson (*Corydalus cornutus*), a large aquatic insect of nocturnal habits, seldom seen except when it approaches a bright light. The larvæ are commonly known as hellgramites, and are usually found under stones in the beds of streams, though sometimes seen among wet rubbish near water. How a woodpecker could obtain these creatures is a mystery, but 1 stomach of the downy contained the remains of at least 4 of the larvæ, and in another was 1 in the pupal stage.

Spiders, millepeds, pseudoscorpions, sowbugs, and a few snails aggregate 4.09 per cent, and complete the quota of the animal food.

The following is a list of insects identified in the food:

COLEOPTERA.

<i>Amara</i> sp.	<i>Platydema</i> sp.
<i>Gynandropus hylacis</i> .	<i>Helops æreus</i> .
<i>Stenolophus</i> sp.	<i>Notoxus alamedæ</i> .
<i>Ips fasciatus</i> .	<i>Pandeletejus hilaris</i> .
<i>Tenebrioides bimaculata</i> .	<i>Dorytomus mucidus</i> .
<i>Dolopius lateralis</i> .	<i>Dorytomus brevicollis</i> .
<i>Melanotus</i> sp.	<i>Desmoris constrictus</i> .
<i>Chrysobothris</i> sp.	<i>Gymnetron teter</i> .
<i>Catorama</i> sp.	<i>Conotrachelus naso</i> .
<i>Aphodius inquinatus</i> .	<i>Cryptorhynchus ferratus</i> .
<i>Elaphidion</i> sp.	<i>Centrinus</i> sp.
<i>Rhagium lineatum</i> .	<i>Balaninus</i> sp.
<i>Oberea</i> sp.	<i>Xyloterus bivittatus</i> .
<i>Diachus auratus</i> .	<i>Hylesinus aculeatus</i> .
<i>Gastroidea cyanea</i> .	<i>Piezocorynus mixtus</i> .
<i>Melasoma californica</i> .	

HYMENOPTERA.

Ants (*Camponotus marginatus* and *C. pennsylvanicus*).

LEPIDOPTERA.

Tent caterpillar (*Malacosoma* sp.).
Cotton bollworm (*Heliothis obsoletus*).

Codling moth (*Carpocapsa pomonella*).

HEMIPTERA.

False chinch bug (<i>Piesma cinerea</i>).	Oak scale (<i>Kermes</i> sp.).
Red bug (<i>Largus succinctus</i>).	Olive scale (<i>Saissetia oleæ</i>).
White scale (<i>Aspidiotus</i> sp.).	Plum and cherry scale (<i>Eulecanium cerasifer</i>).

ORTHOPTERA.

Large meadow grasshopper (*Orchelimum glaberrimum*).

NEUROPTERA.

Dobson (*Corydalus cornuta*).

Vegetable food.—Fruit was eaten to the extent of 5.85 per cent of the whole food. Most of it is of useless wild varieties. Ten species were identified by their seeds, of which the *Rubus* fruits, i. e., raspberries or blackberries, might have been cultivated, but probably were not. They were found in only 1 stomach. A number of stomachs contained fruit pulp, which could not be further identified and may have been cultivated. Corn was found in 20 stomachs, most of it taken in the winter and early spring months, so that it was waste grain, except that found in 2 stomachs in August and September, which was probably in the milk. A few other stomachs held what was thought to be grain of some kind, but was too finely ground for further identification. Grain of all kinds aggregates 1.66 per cent.

The poison *Rhuses* (*Rhus radicans*, *R. vernix*, *R. diversiloba*, and *R. toxicodendron*) seem to afford a favorite winter food for many birds. While the seeds themselves are so thoroughly protected by a hard, horny coating that they are seldom broken in the stomachs, they are overlaid by a white waxy pulp, which easily comes off, and is probably very nutritious. These seeds were found in 86 stomachs of the downy woodpecker, and they amount to 5.93 per cent of the food. Unfortunately they germinate freely after they have been voided, and probably these birds are the most efficient agents in distributing these noxious plants. Mast, i. e., acorns, beechnuts, chestnuts, hazelnuts, chinquapins, with a few other smaller seeds, amounts to 8.20 per cent of the food. This food is eaten in every month—the most in January and the least in July. A little cambium and some rubbish make up the remainder of the vegetable food, 2.31 per cent. The charge sometimes made that the downy injures trees by eating the inner bark is disproved. It eats cambium rarely and in small quantities.

The following seeds and fruits were found in the downy's food:

Bayberry (<i>Myrica carolinensis</i>).	Sorrel (<i>Rumex</i> sp.).
Hornbeam (<i>Ostrya virginiana</i>).	Smartweed (<i>Polygonum</i> sp.).
Beech (<i>Fagus americanus</i>).	Pokeweed (<i>Phytolacca decandra</i>).
Oak (<i>Quercus</i> sp.).	Blackberry or raspberry (<i>Rubus</i> sp.).

Mountain ash (*Sorbus americana*).

Juneberry (*Amelanchier canadensis*).

Poison ivy (*Rhus radicans*).

Poison oak (*Rhus diversiloba*).

Woodbine (*Parthenocissus quinquefolia*).

Flowering dogwood (*Cornus florida*).

Rough-leaved dogwood (*Cornus asperifolia*).

Alternate-leaved dogwood (*Cornus alternifolia*).

Mullein (*Verbascum thapsus*).

Elderberry (*Sambucus canadensis*):

Sunflower (*Helianthus* sp.).

Blueberry (*Vaccinium* sp.).

Summary.—The foregoing discussion of the food of the downy woodpecker shows it to be one of our most useful species. The only complaint against the bird is on the score of disseminating the poisonous species of *Rhus*. However, it is fortunate that the bird can live on this food when it is difficult to procure anything else. The insect food selected by the downy is almost all of species economically harmful.

RED-COCKADED WOODPECKER.

(*Dryobates borealis*.)

The red-cockaded woodpecker is an inhabitant of the Lower Austral zone of the Southeastern States from southern Virginia to eastern Texas and southern Missouri. Pine woods are its favorite haunts, and a large percentage of its food is obtained from pine trees. No complaints have yet been heard that this bird harms crops or forest trees, nor do the contents of its stomach indicate that such is the case. So far as known, it does not frequent orchards or cultivated land.

In the investigation of this bird's food 76 stomachs were available, taken in the four States of Alabama, Florida, Louisiana, and Texas. They were collected in every month except June and July. Of the total food 81.06 per cent was composed of insects, and the remainder, 18.94 per cent, of vegetable matter, mostly seeds of conifers.

Animal food.—Useful Coleoptera, i. e., carabids, were found in 7 stomachs, and amount to 0.53 per cent of the whole food. Other beetles, a large part of them the larvæ of wood-boring species, aggregate 10.49 per cent of the annual diet. Of these a number were weevils or snout beetles. Of the two identified beetles in the list which follows, the first belongs to the Chrysomelidæ or leaf-eating beetles; the other, *Trogosita virescens*, is one of the most beneficial species, since it preys upon the more destructive bark beetles and bark-boring grubs. Ants are evidently the favorite food. They were eaten in every month of which we have a record, and amount to a good percentage in each. December, with a percentage of 27.43, was apparently the month of least consumption, and September shows the maximum of 79 per cent, but we have hardly enough data to obtain final figures. The average for the year is 56.75 per cent, a record which is exceeded by that of only one other bird yet studied.

Hemiptera are eaten to the extent of 8.16 per cent of the food, and a good proportion of them are scales or bark lice. The others are mostly pentatomids or soldier-bugs. Nearly all were taken in the five months from December to April, inclusive, and two-thirds of them in December and January. These insects, and especially the pentatomids, are lovers of warm weather and sunshine, and many of them live on fruit. It seems probable that this bird gets them from their hibernating places. Grasshoppers, crickets, cockroaches, caterpillars, white ants (*Termes*), and spiders make up the rest of the animal food, 5.13 per cent. The cockroaches were in the form of their egg cases (oötheca).

The following is a list of insects identified in the stomachs:

COLEOPTERA.

Gastroidea sp.

Trogosita chloridea.

Trogosita virescens.

Tomicus cacographus.

HYMENOPTERA.

Ant (*Camponotus socius*).

Ant (*Cremastogaster leviuscula*).

HEMIPTERA.

Green tree bug (*Nezara hiliaris*).

Vegetable food.—The greater part of the vegetable food consists of mast, mostly composed of the seeds of conifers. They were found in 26 of the 76 stomachs, and appear to be a somewhat regular article of diet, especially in the colder months. The total amount for the year is 11.13 per cent. Fruit pulp, poison-ivy seeds, bayberry seeds, seeds not identified, cambium, and rubbish each occurred in a few stomachs, and altogether amount to about 8 per cent of the food. Fruit pulp was found in 5 stomachs, but none of it could be further identified. Cambium was contained in 4 stomachs, and seeds of poison ivy in 1. Evidently this food has little economic interest.

The following seeds were identified in the food:

Bayberry (*Myrica carolinensis*).

Magnolia (*Magnolia fœtida*).

Poison ivy (*Rhus radicans*).

Pine (*Pinus* sp.).

Summary.—From this brief review of the food of the red-cockaded woodpecker it is evident that it does little if any damage by eating products of husbandry, and that it does good work in the forest by devouring wood-boring larvæ. No doubt it aids in distributing the seeds of the pines upon which it feeds.

NUTTALL WOODPECKER.

(*Dryobates nuttalli*.)

This bird is much like the downy in its quiet demeanor, its lack of fear of man, and its unobtrusive industry in searching for food. It is only a trifle larger than the downy, and its foraging and nesting

habits are similar. Its range is practically confined to California, though it extends slightly beyond the boundaries at the northern and southern ends of the State.

The food of the Nuttall is much like that of the downy, the principal difference being in the relative proportions of the constituents. Only 53 stomachs of the Nuttall were available for examination—entirely too few to furnish final results, but enough to give an idea of the general character of the food. In the first analysis the food divides into 79.41 per cent of animal matter and 20.59 of vegetable. This differs but little from the record of the downy.

Animal food.—The largest item in the diet of the Nuttall consists of beetles of several families. The total for the year is 28.86 per cent. Of these the useful Carabidæ are barely represented. The remainder are divided among about a dozen families, of which the very harmful Cerambycidæ and Elateridæ in the larval stage are the most prominent. Ants amount to 8.19 per cent and are unevenly distributed, and the indications are that the stomachs are entirely too few to give trustworthy data on this item. Hymenoptera other than ants were eaten to the extent of 3.50 per cent. This again is not a reliable result, as nearly all of them were found in one stomach taken in December. Hemiptera, or bugs, amounted to 14.76 per cent. A few of these were scales and plant lice, but the majority were of the larger species. Two stomachs contained each between 30 and 40 box-elder bugs (*Leptocoris trivittatus*). These insects have a way of becoming very abundant at times and making a nuisance of themselves by invading buildings in search of winter quarters. Caterpillars stand third in the dietary of the Nuttall woodpecker and are eaten more regularly than any other food except beetles. They amount to 14.21 per cent. No special pest was identified, but some were evidently wood-boring species. A few flies, raphidians, pseudoscorpions, spiders, and millepeds make up the rest of the animal food, 9.89 per cent.

Following is a list of insects identified in the stomachs of the Nuttall:

COLEOPTERA.

Glyptoscelis albidus.
Gastroidea sp.

Blapstinus sp.
Balaninus sp.

HEMIPTERA.

Sinea diadema.

Leptocoris trivittatus.

ISOPTERA.

White ant (*Termes* sp.).

Vegetable food.—Fruit was eaten to the extent of 8.49 per cent. It was found in 15 stomachs, of which 2 contained rubus seeds; 5, elderberries; and the rest, pulp not further identified, except that

in 1 stomach it was thought to be apple. Flower buds were found in 1 stomach. Poison oak (*Rhus diversiloba*) was noted in 9 stomachs, mast in 5, cambium in 2, and rubbish, etc., in 5. Altogether they amounted to 12.10 per cent, and made up the quota of vegetable food. None of them was eaten to a sufficient extent to be of any economic interest.

The following fruits were found in the stomachs:

Blackberry or raspberry (*Rubus* sp.).
Elderberry (*Sambucus glauca*).

Poison oak (*Rhus diversiloba*).

Summary.—In its animal food the Nuttall woodpecker is beyond criticism. Practically all of the insects eaten are either pests or of no positive benefit. While some fruit is eaten, it consists largely, and perhaps entirely, of wild varieties. Probably the worst that can be said of the bird is that it helps in the distribution of poison-oak seeds.¹

THREE-TOED WOODPECKERS.

(*Picoides arcticus* and *P. americanus*.)

The three-toed woodpeckers are residents of the Boreal zones of North America, in Alaska, Canada, the northeastern United States, and in the mountains of the Western States, south to southern New Mexico and to central California. The two species, including the two subspecies of *americanus*, are so similar in habits that they may be treated together. All are residents of coniferous forests, from which they sometimes wander a short distance in winter. The trunks of scaly-barked conifers, such as spruces, hemlocks, tamaracks, and lodgepole pines, are their favorite hunting grounds, and here they excavate burrows in which they rear their young and find shelter at night.

In their choice of food these two species are as closely allied as in other respects. The great bulk consists of the larvæ of wood-boring beetles or moths. These are eaten with great regularity throughout the year, but somewhat more in the colder months than in summer. In the dead of winter, when all insect life is apparently quiescent, these birds still obtain their daily food. Flies and bees no longer sport in the sunshine; butterflies and flowers are replaced by sleet and snow; the beetles are either dead or snugly ensconced in crevices in the bark, awaiting the return of warmth, while the larvæ repose in their burrows of solid wood, apparently safe from all disturbance. But undaunted by cold and undeterred by hard work, our intrepid little friends tear open the secure retreats in the bark, or chisel into the solid wood, and feast upon the luckless insects.

Unfortunately only 28 stomachs of *Picoides arcticus* and 23 of *P. americanus* were available for examination. There are few birds

¹ Another species of *Dryobates* (*D. arizonæ*), of which no stomachs have been received, inhabits the mountains from northeastern Arizona and northwestern New Mexico south into Mexico.

which eat more of the pests of the forests than do the three-toed woodpeckers; and while we have no doubt determined the principal food factors, there are many minor questions for the solution of which additional material is necessary.

In the first analysis the food divides into 88.69 per cent of animal matter to 11.31 of vegetable for *arcticus*, and 94.06 per cent of animal to 5.94 of vegetable for *americanus*. The largest item with both species is wood-boring coleopterous larvæ. These amount to 64.25 per cent with *arcticus* and 60.66 with *americanus*. Caterpillars, which in this case are mostly wood-boring species, amount to 12.88 and 14.45 per cent for the two birds respectively. The total of wood-boring larvæ, including both caterpillars and beetles, is 77.13 per cent for *arcticus* and 75.11 per cent for *americanus*, or more than three-fourths of the food of each species. Stomachs containing 15 to 20 of these grubs are very common, and one held 34. Probably the stomach is filled several times each day, and it does not seem unreasonable to assume that a bird will eat 50 of these insects every 24 hours for 6 months and at least 25 daily for the other half of the year. At this rate one bird will annually destroy 13,675 of these destructive grubs. If this assumption be true, the birds of these two species must destroy an immense quantity of wood-boring insects, even if they do not cause any perceptible diminution in their numbers. Beetles other than wood-borers amount to 3.41 per cent for *arcticus* and 10.39 for *americanus*. A considerable proportion of these were weevils, including quite a number of engravers (*Scolytidæ*). They are, however, eaten so irregularly as to indicate that they are taken only incidentally and are not sought, as are the wood-boring grubs. Ants constitute 6.35 per cent of the food of *arcticus* and 8.29 of that of *americanus*. None of these were taken in winter, and most of them were eaten in spring and summer. The *Picoides* do not belong to the ant-eating group of woodpeckers. A few other insects and spiders amount to less than 1 per cent for each species and make up the remainder of the animal food.

Vegetable food.—Vegetable matter constitutes 11.31 per cent of the stomach contents of *arcticus* and 5.94 per cent of that of *americanus*. It can all be included in four items: Fruit, mast, cambium, and rubbish. Fruit skins were found in only 1 stomach of *americanus* and mast in but 1 stomach of *arcticus*. Cambium was found in 10 stomachs of *arcticus* and 8 of *americanus*. This indicates that these birds do some pecking at the bark of living trees for other purposes than getting insects, but no complaints have yet been made, from which we infer that little or no damage is done; in fact the amount contained in the stomachs is not large, a little less than 10 per cent. Rubbish, consisting principally of rotten wood, was found in 9

stomachs. Where a bird pecks wood as much as do these, it is no wonder that some of it is swallowed with the grubs that are embedded therein.

Summary.—The foregoing discussion of the food of the two species of *Picoides* shows that these birds act as “conservators of the forest” in the strongest sense. Three-fourths of their food consists of the direst enemies of forest trees. In the Report on Forest Insects by the United States Entomological Commission, some 25 species of cerambycid and buprestid beetles are noted as preying upon the ash tree and 35 upon the pine. Since the family Cerambycidae contains upward of 7,500 species, of which 600 are found in America, since all pass their larval stage within the substance of some tree or woody plant, and since many remain in the larval state two or three years, evidently they inflict upon forest trees and other plants an immense amount of damage. Probably there are not many other agencies more destructive to timber than this family of beetles. Nor is timber safe even after it has been cut. Logs lying in the mill yard or forest may be ruined in a single season if these creatures are not prevented from depositing their eggs. So long do some of these larvæ live in the wood that they sometimes emerge after it has been converted into furniture and passed into household use. A very efficient check upon the undue increase of these insects is found in the woodpeckers, especially the two species of *Picoides*. In orchards, or in parks, it may be easy to combat insect enemies by insecticides or other artificial means, but in the forest this is more difficult and expensive, and it behooves the forester to take advantage of all helpers which Nature has provided; among these, insectivorous birds must take high rank. It is unfortunate that in most places three-toed woodpeckers are not as numerous as many other species, and for this reason they should be protected and encouraged in every possible way.

YELLOW-BELLIED WOODPECKER OR SAPSUCKER.

(*Sphyrapicus varius* and subsp.)

The yellow-bellied woodpecker or sapsucker (Pl. II) is probably the most migratory of all our woodpeckers. It breeds throughout the whole of southern Canada from ocean to ocean and thence southward to northeastern California, western Texas, northern Missouri, northern Ohio, and Massachusetts, and in the mountains south to North Carolina. It winters from near the southern limit of the breeding range south to Mexico, Cuba, and Costa Rica.

It is to this species that the term sapsucker is most often and most justly applied, for it drills holes in the bark of certain trees and drinks the sap. It feeds also on cambium, insects, and wild fruits and berries.

In writing of the habits of these woodpeckers in northern New York, in 1878, Dr. Merriam states:

They really do considerable mischief by drilling holes in the bark of apple, thorn-apple, and mountain ash trees in such a way as to form girdles of punctures, sometimes 2 feet or more in breadth (up and down), about the trunks and branches. * * * The holes, which are sometimes merely single punctures, and sometimes squarish spaces (multiple punctures) nearly half an inch across, are placed so near together that not infrequently they cover more of the tree than the remaining bark. Hence, more than half of the bark is sometimes removed from the girdled portions, and the balance often dries up and comes off. Therefore it is not surprising that trees which have been extensively girdled generally die, and mountain ash are much more prone to do so than either apple or thornapple trees, due, very likely, to their more slender stems.¹

The late Frank Bolles has published some interesting detailed observations respecting the food habits of the sapsucker. His conclusions are:

That the yellow-bellied woodpecker is in the habit for successive years of drilling the canoe birch, red maple, red oak, white ash, and probably other trees, for the purpose of taking from them the elaborated sap, and in some cases parts of the cambium layer; that the birds consume the sap in large quantities for its own sake and not for insect matter which such sap may chance occasionally to contain; that the sap attracts many insects of various species, a few of which form a considerable part of the food of this bird, but whose capture does not occupy its time to anything like the extent to which sap drinking occupies it; * * * that the forest trees attacked by them generally die, possibly in the second or third year of use.²

Mr. Bolles shot 8 sapsuckers in July and August, 1890. Their stomachs "were well filled with insects." Some of these were examined by Mr. Samuel H. Scudder, who states:

The insects in the different stomachs are in all cases almost exclusively composed of the harder chitinous parts of ants. In a cursory examination I find little else, though one or two beetles are represented, and No. 4 must have swallowed an entire wasp of the largest size, his head and wings attesting thereto.³

Mr. Bolles proved by experiment that concentrated sap (saturated with sugar) is not sufficient to sustain life, even with the addition of a small percentage of insects. The logical inference is that sap, while liked by the birds and consumed in large quantities, holds a subordinate place as an article of food.

J. Maurice Thompson says of the sapsucker:

Its food is sap or juices of green trees. It eats nothing else. * * * The principal trees from which it obtains its food are the maples, hickories, cedar, apple, pear, southern pine, and swamp ash.⁴

In speaking of this species Dr. Hopkins mentions the finding of a small pitch pine tree that had recently died from injuries by woodpeckers. The bird evidently attacks the healthy tree for the sole

¹ Bull. Nuttall Ornith. Club, IV, 3-5, January, 1879.

² Auk, VIII, 270, July, 1891.

³ Auk, VIII, 269, July, 1891.

⁴ Appleton's Journal, VIII, 631, Dec. 7, 1872.

purpose of feeding on the inner bark. Thus, instead of destroying insects, it made the conditions favorable for the attack of bark beetles and other insects which had bred in the bark and wood in considerable numbers. To anticipate the possible conclusion that the woodpecker intended to thus trap the insects and return to eat them, Dr. Hopkins added that at the time the observations were made, the insects had not been molested.¹

This investigation of the food of the yellow-bellied sapsucker is based upon examination of the contents of 313 stomachs, collected in 24 States, Canada, and the District of Columbia, and distributed over 12 months of the year. Of this food 49.31 per cent is animal matter and 50.69 vegetable. This is the first species discussed in which the vegetable part of the diet is greater than the animal. This is true of 5 of the 16 species under consideration.

Animal food.—Useful beetles, i. e., predaceous ground beetles and ladybirds (Coccinellidæ), are eaten by the sapsucker to the extent of only 0.91 per cent of the whole food. Other beetles amount to 4.54 per cent, and are made up of weevils, dung beetles (*Aphodius*), and click beetles, with a few cerambycid larvæ. Ants amount to 34.31 per cent of the whole food, or 69 per cent of the animal part. They are evidently favorite food, being eaten quite regularly through the year, although the months from May to August, inclusive, show the highest percentages, averaging over 68 per cent. Other Hymenoptera amount to 2.64 per cent, and are very irregularly taken. October appears to be the month of greatest consumption, with 15.07 per cent. Hemiptera are eaten very sparingly. Scales (Coccidæ) were found in two stomachs, and in one were identified as the plum scale (*Eulecanium cerasifex*); these, with a few stink bugs, amount to a little less than 1 per cent for the year. A few miscellaneous insects and spiders aggregate 5.44 per cent. The insects consist of May flies, stone flies, grasshoppers, crickets, tree hoppers, caterpillars and moths, and flies (Diptera). A few eggs were found, probably those of the tent caterpillars (*Malacosoma*).

The following is a list of insects identified in the stomachs:

COLEOPTERA.

<i>Coccinella 9-notata.</i>	<i>Aphodius inquinatus.</i>
<i>Coccinella sanguinea.</i>	<i>Dichelonycha</i> sp.
<i>Adalia bipunctata.</i>	<i>Xanthonia 10-notata.</i>
<i>Anatis</i> sp.	<i>Diabrotica 12-punctata.</i>
<i>Læmophæus biguttatus.</i>	<i>Canifa pallipes.</i>
<i>Onthophagus</i> sp.	<i>Pandeletejus hilaris.</i>
<i>Aphodius fimetarius.</i>	<i>Balaninus</i> sp.

HYMENOPTERA.

<i>Vespa maculata.</i>	<i>Pimpla</i> sp.
<i>Vespa arenaria.</i>	

¹ Hopkins, A. D., Bull. 56, West Virginia Agric. Exper. Sta., p. 355, 1890.

HEMIPTERA.

Plum or cherry scale (*Eulecanium cerasifex*).

LEPIDOPTERA.

Tent caterpillar (*Malacosoma* sp.).

Vegetable food.—The two principal items of vegetable food are fruit and cambium. Twenty-two species of wild fruit and two of cultivated were identified. In general the least fruit is eaten in spring and summer and the most in fall and winter. Altogether it was found in 118 stomachs, none in May and the most, 71.26 per cent, in November. It was evidently mainly berries left on the bushes. Seeds of *Rubus* fruit, which may be either wild or cultivated, were found in two stomachs, and two contained what was thought to be apple pulp. The total of the fruit is 28.06 per cent of the food, but evidently has little economic interest. The apple was probably the only cultivated variety and this was eaten only twice. Cambium, or the inner bark of trees, was eaten every month, but mostly in winter and spring. The greatest consumption is in April, 48.95 per cent, and the least in November, 1.53 per cent. It was found in 127 stomachs and was the entire contents of 12. The average for the year is 16.54 per cent, which is exceeded by only two items—fruit and ants. The subjects of cambium and sap sucking have been discussed on a previous page. Mast, poison *Rhus* seeds, mullein, and rubbish collectively make up the remaining 6.09 per cent. Mast was found in 15 stomachs, and is evidently not specially sought. Poison ivy seed was contained in seven stomachs and poison sumac in one, so the sapsucker does little harm by distributing the seed of these noxious plants. Rubbish was found in 48 stomachs. It was mostly bits of the outer bark of trees, evidently swallowed when pecking for cambium.

The following fruits and seeds were found in the food:

Red cedar (<i>Juniperus virginiana</i>).	Black alder (<i>Ilex verticillata</i>).
Greenbrier (<i>Smilax</i> sp.).	Burning bush (<i>Euonymus americanus</i>).
Hackberry (<i>Celtis occidentalis</i>).	Frost grape (<i>Vitis cordifolia</i>).
Sassafras (<i>Sassafras sassafras</i>).	Virginia creeper (<i>Parthenocissus quinquefolia</i>).
Blackberry or raspberry (<i>Rubus</i> sp.).	Flowering dogwood (<i>Cornus florida</i>).
Shad or service berry (<i>Amelanchier canadensis</i>).	Sour gum (<i>Nyssa sylvatica</i>).
Choke cherry (<i>Prunus virginiana</i>).	Blueberry (<i>Vaccinium</i> sp.).
Black cherry (<i>Prunus serotina</i>).	Black nightshade (<i>Solanum nigrum</i>).
Poison sumac (<i>Rhus vernix</i>).	Mullein (<i>Verbascum thapsus</i>).
Poison ivy (<i>Rhus radicans</i>).	Red-berried elder (<i>Sambucus pubens</i>).
American holly (<i>Ilex opaca</i>).	Elder (<i>Sambucus</i> sp.).
Ink berry (<i>Ilex glabra</i>).	Poke berry (<i>Phytolacca decandra</i>).
Swamp holly (<i>Ilex decidua</i>).	

Summary.—In the animal food of the yellow-bellied sapsucker, ants are the most important item, and while of no great economic

interest they must be reckoned in the bird's favor. On the other hand, the damage this sapsucker inflicts in eating the cambium and sap of trees is so serious that it more than counterbalances any good that the bird does in other directions. Investigations show that the damage to timber, especially in the Southern States, is extensive and serious.¹

RED-BREASTED SAPSUCKER.

(*Sphyrapicus ruber* and subsp.)

The red-breasted sapsucker is confined to the Pacific coast region, and ranges from central Lower California in winter, north in summer through California, Oregon, and Washington to Alaska. Naturally it seems to be a forest bird, but it takes kindly to orchards and ranches. It is migratory to a slight extent, but summers as far south as the San Bernardino Mountains. It makes, however, a minor migration in many localities by descending the mountains to the valleys, in which it winters.

Speaking guardedly of this bird, Maj. Charles Bendire says:

I am inclined to think that this species does not indulge in the habit of girdling trees for the sap and the soft inner bark (cambium) to the same extent that *Sphyrapicus varius* does; at any rate, not during the breeding season.²

On the other hand, Prof. Cook, of Claremont, California, gives the following direct testimony:

Sphyrapicus ruber is the sapsucker of southern California. It taps fruit trees, especially prune and apricot, and evergreens. Its mischief seems much more serious than that of its congener of the East, as trees are frequently killed by reason of its punctures, although these latter are more distant and less numerous. I never knew a tree to be killed by the sapsuckers in Michigan. The evil in California is wrought in summer, when the dry season has enfeebled the tree, and this is a possible explanation of the more serious harm to the trees of this region.³

In the face of this conflicting testimony we may infer that the habits of the bird vary with the locality.

In Oregon the writer observed trees of white birch and mountain ash growing in a village yard which were badly injured by this bird.

Only 34 stomachs of this species were available for examination, and none were taken in the months from April to August, inclusive, while 29, or five-sixths of all, were collected in October, November, and December. Only some general ideas of the food can be expected from so little material.

In the first analysis we find practically 69 per cent of animal food to 31 of vegetable.

Animal food.—This species is a much greater insect eater than *S. varius*. Ants, the largest item, amount to 42.49 per cent. They

¹ A bulletin upon this subject is in preparation by W. L. McAtee.

² Bendire, Maj. Charles, Life Histories of North American Birds, II, 94, 1895.

³ Cook, A. J., Auk, XIII, 85, 1896.

were eaten freely in every month in which stomachs were taken except February, and 4 stomachs contained nothing else. Other Hymenoptera aggregate a little more than 7 per cent. Beetles of all kinds amount to only 4 per cent, and none of them are of useful species. The greater number belong to the family Chrysomelidæ, or leaf-eaters. *Diachus auratus* was the only one identified. One stomach contained the remains of *Rhinosimus pallipes*, a member of the Pythidæ, a small and rather rare family. Caterpillars were found in 2 stomachs, locust eggs in 1, and a caterpillar formed the entire contents of 1. All these amount to 15 per cent, and make up the rest of the animal food.

Vegetable food.—Of the vegetable food, fruit constitutes 12.69 per cent. Berries of the pepper tree (*Schinus molle*) were found in 3 stomachs, cascara (*Rhamnus californicus*) in 1, pulp not further identified in 3, and figs in 1. Only the last is of any economic importance. Seeds of poison oak were found in 4 stomachs, wax myrtle (*Myrica californica*) in 1, and unidentified seeds in 1. Seeds altogether amount to 5.96 per cent. Cambium was found in only 6 stomachs, but aggregated 11.13 per cent, which is three-fourths as much as was eaten by *S. varius*. Nearly all that had taken it at all had eaten a good percentage. Stomach examinations alone do not enable us to settle the status of the bird, for which more material and some field observation will be necessary.

Summary.—It appears that the red-breasted sapsucker attacks and injures trees, but whether it is as destructive as its eastern relative is not yet known, and more material and further observations are necessary to settle the question.

WILLIAMSON SAPSUCKER.

(*Sphyrapicus thyroideus*.)

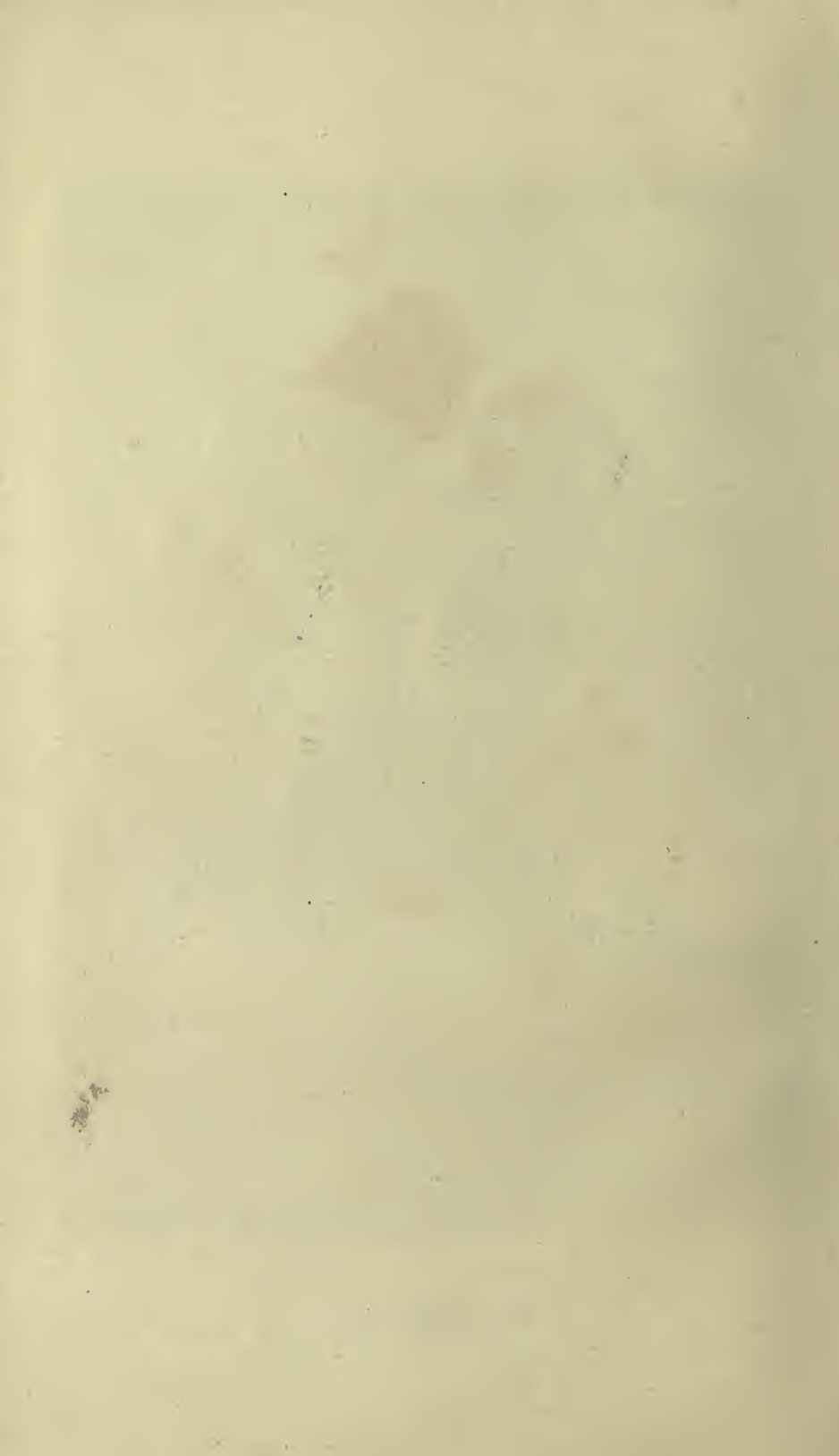
The Williamson sapsucker is a bird of mountains and evergreen forests. Its range extends from the eastern slope of the Rocky Mountains westward to the Pacific, and from Arizona and New Mexico northward to British Columbia; south in winter to Mexico. The bird is likely to be of little economic interest except in connection with forests. Only 17 stomachs of this species have been received by the Biological Survey, and all but 2 of these were collected in the months from June to September, inclusive. Conclusions based on the examination of so little material must be considered as only tentative. In the first analysis of the food it divides into 87 per cent of animal matter and 13 of vegetable.

Animal food.—Of the animal food a mere trace was shown of click-beetles (Elateridæ) and less than 1 per cent of crane flies (Tipulidæ). The remainder, 86 per cent, consists entirely of ants, with which 7 stomachs were entirely filled. This record places this bird at the



BEUKER & KESSLER CO LITH PHILA

YELLOW-BELLIED SAPSUCKER.





PREUNKER & KESSLER CO. LINN. PHILA.

RED-HEADED WOODPECKER (ADULT AND YOUNG).

head of the woodpeckers in ant eating, but the material is too scanty to warrant final conclusions.

Vegetable food.—Fruit pulp in 1 stomach and rubbish in another, each amounted to less than 1 per cent of the year's food. Cambium occurred in 5 stomachs, and formed the bulk of the vegetable food, 12.55 per cent of the whole.

Summary.—These results would indicate a very limited diet for this bird, but it is altogether probable that a greater number of stomachs would materially modify these figures. They show, however, that the bird eats ants and cambium, if they are not conclusive as to what it does not eat.

PILEATED WOODPECKER.

(*Phlæotomus pileatus* and subsp.)

The pileated woodpecker, logcock, woodcock, or cock of the woods, as it is variously called, is the largest member of the family now living in the United States, except the ivory-billed woodpecker, which is very rare. The logcock is essentially a forest bird, and is rarely found except in rather extensive tracts of timber. It is usually shy and retiring, difficult to approach, and better known by its work than by sight. Its large size, loud voice, and habit of hammering upon dead limbs combine to make it a conspicuous inhabitant of the forest. Its strength is wonderful, and it is hard to believe that a bird can so completely destroy a stump or log. Strips of decayed wood 2 feet long, 4 inches wide, and an inch thick are often torn from a stump and thrown several yards away.

Woodpeckers signal each other by hammering upon a dead and hollow limb or trunk of a tree, or upon the metallic cornice of a building. The pileated is an adept at such telegraphing, and its tattoo on a particularly resonant piece of timber can be heard for more than a mile.

The pileated woodpecker seems to be distributed over the United States in general, and north to Canada, but is absent from some large areas, particularly in the southwestern United States, even where there are extensive forests and other conditions apparently suited to its tastes. It is not migratory in the usual sense, but in winter wanders extensively, usually accompanied by its mate, which leads to the belief that it mates for life.

In the laboratory investigation of this bird's food 80 stomachs were available. They were collected in 14 States, the District of Columbia, and Canada, and are distributed in every month, though May is represented by only 1. The animal food amounts to 72.88 per cent and the vegetable to 27.12. The former consists principally of beetles and ants, and the latter of wild fruits.

Animal food.—Beetles amount to 22.01 per cent. Nearly all were in the larval stage, and evidently were dug out of dead and decaying wood. They belong to the Cerambycidae, the Buprestidae, and the Elateridae, all of them wood-borers, with some Lucanidae and Scarabaeidae, many species of which breed in rotting timber. Carabidae, or useful ground-beetles, were found in only 6 stomachs and amount to a small fraction of 1 per cent.

Ants aggregate 39.91 per cent and constitute more than half of the animal food. They were found in 48 stomachs, and in one, 2,600 were counted; in another, 2,080; and in a third, 2,000. They are mostly of the larger species that live in decaying timber. These two items, beetles and ants, make up the bulk of the animal food, 61.92 per cent. It is evident that they are the objects of the bird's search when he is foraging over the trunks of dead trees or logs, and that other insects are taken only incidentally. Flies, caterpillars, fragments of cockroaches and their egg cases (oötheca), bits of grasshoppers, some sawflies, and white ants, no one of which amounts to a respectable percentage, aggregate 10.96 per cent, the balance of the animal food.

The following is a list of insects identified in the stomachs:

COLEOPTERA.

Anisodactylus sp.

Upis ceramboides.

Allorhina nitida.

Chalcophora sp.

Cyclocephala sp.

HYMENOPTERA (ANTS).

Camponotus pennsylvanicus.

Cremastogaster læviuscula.

Camponotus herculeanus.

LEPIDOPTERA.

Caterpillar (*Scolecocampa liburna*).

Vegetable food.—The largest item of vegetable food, and in fact the only one of importance, is wild fruit, which amounts to 22.56 per cent, and of which 19 species were identified. This is probably eaten in every month, but in the stomachs examined none was found in April, May, or June; but as only 6 stomachs were collected in those months, the record is not conclusive. The only part of the fruit which can possibly have any economic interest is some *Rubus* seeds found in 1 stomach and some unidentified seeds in 5, but probably these were wild like the others. Seeds of poison ivy (or poison oak), poison sumac, dwarf sumac, a little cambium, and mast, with some rubbish, altogether amount to 4.56 per cent and complete the vegetable food.

The following vegetable food was found in the stomachs:

Greenbrier (*Smilax glauca*).
 Cat brier (*Smilax rotundifolia*).
 Laurel-leaved greenbrier (*Smilax laurifolia*).
 Hackberry (*Celtis occidentalis*).
 Sassafras berry (*Sassafras sassafras*).
 Blackberry or raspberry (*Rubus* sp.).
 Dwarf sumac (*Rhus copallina*).
 Poison sumac (*Rhus vernix*).
 Poison ivy (*Rhus radicans*).
 American holly (*Ilex opaca*).
 Dahoon holly (*Ilex cassine*).

Frost grape (*Vitis cordifolia*).
 Woodbine (*Parthenocissus quinquefolia*).
 Flowering dogwood (*Cornus florida*).
 Rough-leaved dogwood (*Cornus asperifolia*).
 Sour gum (*Nyssa sylvatica*).
 Tupelo gum (*Nyssa aquatica*).
 Persimmon (*Diospyros virginiana*).
 Fringe tree (*Chionanthus virginica*).
 Elderberry (*Sambucus canadensis*).
 Larger withe-rod (*Viburnum nudum*).
 Black haw (*Viburnum prunifolium*).

Summary.—The food of the pileated woodpecker does not interest the farmer or horticulturist, for it is obtained entirely from the forest or the wild copses on its edge. This bird does not visit either the orchard or the grain field, and all its work in the forest helps to conserve the timber. Unfortunately the bird is so scarce in many places that it is an object of curiosity, and the man or boy with a gun never lets pass a chance to shoot one, although its flesh is unfit for food. In fall and winter it may often be seen in the market in Washington, and probably in cities farther south. Maj. Bendire relates that once when short of provisions he attempted to eat one, but found it extremely unpalatable. Its killing should be strictly prohibited at all times.

RED-HEADED WOODPECKER.

(*Melanerpes erythrocephalus*.)

The handsome redhead (Pl. III) inhabits suitable localities throughout most of southern Canada and the United States east of the Rocky Mountains, but is rare in New England and northeastward. It is a familiar bird on telegraph poles and fence posts and feeds largely on insects found upon these bare surfaces, but the vegetable matter in its stomach shows that it forages elsewhere also.

Fifty years ago Giraud stated that on Long Island the red-headed woodpecker arrives early in April, and during the spring "subsists chiefly on insects. In summer it frequents fruit trees, ripe cherries and pears seeming to be a favorite repast. In the fall it feeds on berries and acorns, the latter at this season forming a large portion of its food."¹

In its fondness for mast it resembles its relative, the California woodpecker. In the northern part of its range, where the oak is replaced by the beech, the redhead makes the beechnut its principal food. Dr. C. Hart Merriam has given much testimony under this head.² He states that in northern New York, where it is one of the

¹ Giraud, J. P., *Birds of Long Island*, p. 180, 1844.

² *Birds of Connecticut*, p. 66, 1877; *Bull. Nuttall Ornith. Club*, III, 124, 1878; *Mammals of the Adirondacks*, p. 226, 1884.

commonest woodpeckers, it subsists almost exclusively on beechnuts during the fall and winter, even picking the green nuts before they are ripe and while the trees are still covered with leaves. He has shown that these woodpeckers invariably remain throughout the winter after good nut yields and migrate whenever the nut crop fails. He says: "Gray squirrels, red-headed woodpeckers, and beechnuts were numerous during the winters of 1871-72, 1873-74, 1875-76, 1877-78, 1879-80, 1881-82, 1883-84, while during the alternate years the squirrels and nuts were scarce and the woodpeckers altogether absent;" and adds that in Lewis County, N. Y., "a good squirrel year is synonymous with a good year for *Melanerpes*, and vice versa." In early spring following a nut year, when the melting snow uncovers the ground, they feed on the beechnuts that were buried during the winter. On April 5, 1878, at Locust Grove, N. Y., he shot 6 whose gizzards contained beechnuts and nothing else.

In an interesting article in the Auk,¹ Mr. O. P. Hay says that in central Indiana during a good beechnut year, from the time the nuts began to ripen, the redheads were almost constantly on the wing, passing from the beeches to some place of deposit. They hid the nuts in almost every conceivable situation. Many were placed in cavities in partly decayed trees; and the felling of an old beech was certain to provide a feast for the children. Large handfuls were taken from a single knot hole. They were often found under a patch of raised bark, and single nuts were driven into cracks in the bark. Others were thrust into cracks in gateposts; and a favorite place of deposit was behind long slivers on fence posts. In a few cases grains of corn were mixed with beechnuts. Nuts were often driven into cracks in the ends of railroad ties, and the birds were often seen on the roofs of houses pounding nuts into the crevices between the shingles. In several instances the space formed by a board springing away from a fence was nearly filled with nuts, and afterwards pieces of bark and wood were brought and driven over the nuts as if to hide them from poachers.

In summer Dr. Merriam has seen the redheads "make frequent sallies into the air after passing insects, which were almost invariably secured." He has also seen them catch grasshoppers on the ground in a pasture.

Dr. A. K. Fisher saw several red-headed woodpeckers feeding on grasshoppers in the streets at Miles City, Mont., in the latter part of July, 1893. Several of the birds were seen capturing these insects near the hotel throughout the greater part of the forenoon. From a regular perch on top of a telegraph pole or cottonwood they descended on their prey, sometimes eating them on the ground, but more often returning to their former post to devour them.

¹ Auk, IV, 194, 195, 1887.

The following interesting observation was made by Dr. G. S. Agersborg, of Vermilion, S. Dak.:¹

Last spring, in opening a good many birds of this species with the object of ascertaining their principal food, I found in their stomachs nothing but young grasshoppers. One of them, which had its headquarters near my house, was observed making frequent visits to an old oak post, and on examining it I found a large crack where the woodpecker had inserted about 100 grasshoppers of all sizes (for future use, as later observation proved), which were put in without killing them, but they were so firmly wedged in the crack that they in vain tried to get free. I told this to a couple of farmers, and found that they had also seen the same thing, and showed me posts which were used for the same purpose. Later in the season the woodpecker whose station was near my house commenced to use his stores, and to-day (February 10) there are only a few shriveled-up grasshoppers left.

The late Mr. Charles Aldrich, of Webster City, Iowa, states that he saw a red-headed woodpecker catching grasshoppers on the prairie half a mile from timber. In Nebraska grasshoppers were found in 4 out of 6 stomachs examined by Prof. Samuel Aughey.

Besides taking fruit and grain, this woodpecker has been accused of destroying the eggs of other birds and even of killing the young; and from Florida comes a report that it enters poultry houses and sucks the eggs of domestic fowls. Mr. Charles Aldrich, of Webster City, Iowa, says that a red-headed woodpecker was seen to kill a duckling with a single blow on the head, and then to peck out and eat the brains.² In view of such testimony, remains of eggs and young birds were carefully looked for in the stomachs examined, but pieces of eggshell were found in only 4.

A very unusual trait has been recorded by Dr. Howard Jones, of Circleville, Ohio. He has seen the red-headed woodpecker steal the eggs of eaves swallows, and in cases where the necks of the nests were so long that the eggs were out of reach, the woodpecker made a hole in the walls of the nest and so obtained the contents. In a colony of swallows containing dozens of nests, not a single brood of young was raised. One of the woodpeckers also began to prey upon hens' eggs, and was finally captured in the act of robbing the nest of a sitting hen.³

The redhead has been accused of doing considerable damage to fruit and grain, and both charges are fairly well sustained. In northern New York Dr. Merriam has seen it peck into apples on the tree, and has several times seen it feed on chokecherries (*Prunus virginiana*).

Mr. August Jahn, of Pope County, Ark., writes that it has damaged his corn to the amount of \$10 or \$15, and Dr. J. R. Mathers, of Upshur County, W. Va., says that the same species feeds on cherries, strawberries, raspberries, and blackberries, and that its depredations are

¹ Bull. Nuttall Ornith. Club, III, 97, 1878.

² Am. Nat., VI, 308, May, 1877.

³ Ornithologist and Oologist, VIII, 56, 1883.

sometimes serious. According to Mr. Witmer Stone, of Germantown, Pa., red-headed woodpeckers have been observed to strip a black-berry patch of all of its fruit. Mr. W. B. McDaniel, of Decatur County, Ga., also reports that the sapsucker and redhead eat grapes and cherries, the loss being sometimes considerable. These examples show the nature of the testimony contributed by eyewitnesses, the accuracy of whose observations there is no reason to doubt. That the stomach examinations do not reveal more damaging evidence against the species is not surprising, for a person seeing a bird eating his choice fruit, or in some other way inflicting damage, is more impressed by it than by the sight of a hundred of the same species quietly pursuing their ordinary vocations. Thus an occasional act is taken as a characteristic habit.

In the food investigation of the redhead 443 stomachs were examined. They were collected in 27 States, the District of Columbia, and Canada, and represent every month, though fewer were taken in the colder season, as the bird is inclined to migrate, and remains in the north only when an abundance of food is assured. Of the stomach's contents, animal matter amounts to 33.83 per cent and vegetable to 66.17.

Animal food.—Beetles amount to about 19 per cent of the food. Of these, 7.34 per cent consist of predaceous ground beetles and tiger beetles, with a few ladybird beetles, all of which are useful. This is the highest percentage of useful insects eaten by any of the woodpeckers. Among the species taken are the fire ground-beetle (*Calosoma calidum*) and the searcher (*C. scrutator*), both predaceous species of large size and vile odor.

Passalus cornutus, one of the staghorns, a large species, was also found, as well as a pair of mandibles belonging to *Prionus imbricornis*, one of the largest species in the United States. The remainder of the beetle food is made up of various families, of which the May beetles (Scarabæidæ) are the most prominent. They amount to 6.31 per cent and are mostly flower-beetles (*Euphoria*) or closely allied genera. A preference for large beetles is a pronounced characteristic of this woodpecker. Weevils were found in 99 stomachs and as many as 12 were counted in one. Such harmful species as *Epicærus imbricatus*, *Phytonomus punctatus*, and *Sphenophorus zææ* were identified in several stomachs. The beetles eaten by the red-head are mostly adults, and such species as creep over the bark of trees or on bare fences or telegraph poles, where the bird loves to forage. Unlike the hairy, downy, and three-toed woodpeckers, the redhead eats very few beetle larvæ or other grubs, or ants that live in wood or other places of concealment. Apparently it is not so fond of pecking wood as are the other species, but on the other hand it has been known to peck holes in telegraph and telephone poles

until they were so weakened as to break down, thereby causing "considerable damage."¹

Ants amount to 5.17 per cent of the food of the redhead, which is the lowest record but one of all the woodpeckers. The greatest number are eaten in June and July, when they aggregate a little more than 14 per cent in each month. As they are mostly taken in the warmer months, it is almost certain that they are captured in the open, not dug out of decaying trees or logs. Hymenoptera other than ants amount to 1.63 per cent. These are of course bees and wasps, and, as this bird is quite skillful in catching insects upon the wing, probably it takes most of them in the air.² In one stomach was found one worker honey bee. Parasitic species were identified in a few stomachs. Like the ants, most of the wasps were taken in midsummer.

Hemiptera, or bugs, are a small but rather regular constituent of the food. They aggregate only 1.89 per cent of the yearly diet, but include some interesting species. A collection of 6 stomachs was received from Ames, Iowa, at a time when a brood of 17-year locusts (*Tibicen septendecim*) was out. These insects had been eaten by every one of the birds, and they averaged 52 per cent of the stomachs' contents. Field observation, as well as stomach examination, shows that cicadas are eaten in their season by all kinds of insectivorous birds big enough to manage such large insects. Cicadas were found in 10 stomachs, but not all were identified as the 17-year species. Scales (Coccidæ), or bark lice, were found in 17 stomachs, and in 5 they were identified as the plum or cherry scale (*Eulecanium cerasifex*). In 1 stomach this species amounted to 60 per cent of the contents. This shows that the bird forages to some extent among the smaller branches and twigs of live trees. A few individuals of several other families of bugs were found, of which Pentatomidæ, or stinkbugs, were the favorites.

Orthoptera, in the shape of grasshoppers, crickets, and cockroaches and their eggs, were eaten very sparingly throughout the year; but in August, the grasshopper month, the redhead takes to the ground, where it feeds quite freely upon these insects. They aggregate 21.17 per cent of its diet in August, and in September 9.53 per cent, amounting in the two months to two-thirds of the grasshoppers taken in the year. The average for the year is 3.58 per cent. There is much testimony that many grasshoppers are stored up for future use. They do not, however, constitute a very large element of the food after September. The redhead may share the instinct

¹ Buchler, M. H., Pennsylvania Telephone Co., in letter to Biological Survey, dated Harrisburg, Pa., March 19, 1895.

² See Merriam, Bull. Nuttall Ornith. Club, III, 126, July, 1878; also Forest and Stream, IX, 451, January 17, 1878.

of its California cousin and store up much food that it never eats, thus contributing to the welfare of pilferers of the food.

Lepidoptera, that is, caterpillars, are apparently not a favorite food of the redhead. A few were eaten in the months from April to October, inclusive, but in May only do they reach 10 per cent of the food. The average for the year is 1.63 per cent. One harmful species, the wheat-head army worm (*Heliothrips albilinea*), was identified in one stomach, which contained about a dozen specimens. Dragonflies, spiders, and millepeds, bits of a crayfish, eggshells, and a few bits of bone and hair of some small rodent, altogether make up the remaining 1 per cent.

The following insects were identified in the stomachs of the redhead:

COLEOPTERA.

<i>Cicindela</i> sp.	<i>Aphodius inquinatus</i> .
<i>Carabus</i> sp.	<i>Aphodius</i> sp.
<i>Calosoma scrutator</i> .	<i>Bolboceras farcetus</i> .
<i>Calosoma calidum</i> .	<i>Dichelonycha</i> sp.
<i>Pasimachus depressus</i> .	<i>Macroductylus subspinosus</i> .
<i>Scarites subterraneus</i> .	<i>Lachnosterna</i> sp.
<i>Pterostichus sayi</i> .	<i>Anomala</i> sp.
<i>Pterostichus</i> sp.	<i>Allorhina nitida</i> .
<i>Amara fulvipes</i> .	<i>Euphoria fulgida</i> .
<i>Galerita janus</i> .	<i>Euphoria inda</i> .
<i>Chlænus</i> sp.	<i>Euphoria sepulchralis</i> .
<i>Geopinus incrassatus</i> .	<i>Prionus imbricornis</i> .
<i>Agonoderus pallipes</i> .	<i>Elaphidion</i> sp.
<i>Anisodactylus discoideus</i> .	<i>Nodonota tristis</i> .
<i>Anisodactylus nigrita</i> .	<i>Gastroidea cyanea</i> .
<i>Anisodactylus</i> sp.	<i>Melasoma scripta</i> .
<i>Tropisternus</i> sp.	<i>Diabrotica 12-punctata</i> .
<i>Sphæridium scarabæoides</i> .	<i>Eleodes tricolorata</i> .
<i>Necrophorus</i> sp.	<i>Meracantha contracta</i> .
<i>Creophilus villosus</i> .	<i>Corymbites cylindricollis</i> .
<i>Staphylinus vulpinus</i> .	<i>Dicerca obscura</i> .
<i>Staphylinus maculosus</i> .	<i>Dicerca</i> sp.
<i>Coccinella 9-notata</i> .	<i>Chrysobothris</i> sp.
<i>Ips fasciatus</i> .	<i>Ptinus dubius</i> .
<i>Melanotus fissilis</i> .	<i>Ceruchus piceus</i> .
<i>Passalus cornutus</i> .	<i>Epicauta</i> sp.
<i>Phanæus carnifex</i> .	<i>Epicærus imbricatus</i> .
<i>Canthon lævis</i> .	<i>Sitones</i> sp.
<i>Canthon</i> sp.	<i>Phytonomus punctatus</i> .
<i>Onthophagus</i> sp.	<i>Hyllobius pales</i> .
<i>Atænius cognatus</i> .	<i>Balaninus</i> sp.
<i>Aphodius fossor</i> .	<i>Sphenophorus zeæ</i> .
<i>Aphodius fimetarius</i> .	<i>Sphenophorus</i> sp.
<i>Aphodius ruficollis</i> .	

HYMENOPTERA.

<i>Apis mellifera</i> .	<i>Ophion</i> sp.
<i>Vespa maculata</i> .	<i>Camponotus</i> sp.



CALIFORNIA WOODPECKER.



Louis Agassiz Fuertes.

BREUKER & KESSLER CO LITH PHILA

LEWIS WOODPECKER.

HEMIPTERA.

<i>Nezara hilaris.</i>	<i>Tibicen</i> sp.
<i>Sinea diadema.</i>	<i>Eulecanium cerasifex.</i>
<i>Tibicen septendecim.</i>	

LEPIDOPTERA.

Wheat-head army worm (*Heliophila albilinea*).

Vegetable food.—Some grain is eaten by the redhead from May to September. In August and September it amounts to 21.73 and 19.67 per cent, respectively. The average for the year is 4.25 per cent. Corn was identified in 64 stomachs and oats in 2. The former was in most cases immature or in the milk, and was more or less mixed with corn silk. Domestic fruit was found in 175 stomachs—that is, if the seeds of blackberries and raspberries and the pulp without seeds were all of domesticated varieties. Blackberries and raspberries were identified in 42 stomachs, domestic cherries in 15, strawberries in 7, and apples in 9. Cultivated fruit was all taken in the months from April to September, inclusive, with the maximum of 16.76 per cent in July. The average for the year is 3.30 per cent. The above account undoubtedly does the bird great injustice, as probably most of the *Rubus* fruit (blackberries and raspberries) was obtained from wayside thickets, and it is almost certain that much of the unidentified pulp contained in 102 stomachs was from wild species. The strawberries also were as likely to be wild as cultivated. Wild fruits were found in 100 stomachs, and 17 species were identified. They were eaten in every month, the most in the colder ones. February appears to be the month of maximum consumption with 50 per cent, but the record is based on only 9 stomachs. The average for the year is 16.90 per cent. Anthers of flowers should perhaps be included in this item. They were found in 4 stomachs.

Mast is evidently a favorite food of the redhead. It appears in the stomachs of every month except March, but as only 3 were taken then the exception is probably accidental. The most was eaten in the four months from October to January, inclusive, and the average for those months is 55.22 per cent, and for the year 23.26 per cent. The great bulk of this is acorns, but some other nuts and large seeds are included. This record for mast eating is, as far as known, exceeded by only a few birds, notably the California woodpecker and the jays.

Miscellaneous vegetable matter amounts to 18.30 per cent. This is made up of cambium, found in 5 stomachs, poison-ivy seeds in 7, several other *Rhus* seeds, and a number of weed seeds. The great bulk of this item, however, is a mass of hard woody granules of very irregular shape and undetermined origin. They were found

in 90 stomachs, and one contained nothing else. They have a resemblance to the woody granules in pear pulp, but are larger and more irregular. It is possible that they are derived from the pulp of some wild fruit. If so, their percentage should be added to the fruit pulp. They have been found in the food of other woodpeckers, but in comparatively small quantities.

The following fruits and seeds were identified:

Bristly greenbrier (<i>Smilax bona-nox</i>).	Frost grape (<i>Vitis cordifolia</i>).
Mulberry (<i>Morus rubra</i>).	Woodbine (<i>Parthenocissus quinquefolia</i>).
Dock (<i>Rumex</i> sp.).	Flowering dogwood (<i>Cornus florida</i>).
Lambs quarters (<i>Chenopodium album</i>).	Rough-leaved dogwood (<i>Cornus asperifolia</i>).
Shadbush or service berry (<i>Amelanchier canadensis</i>).	Panicled dogwood (<i>Cornus candidissima</i>).
Bird cherry (<i>Prunus pennsylvanica</i>).	Sour gum (<i>Nyssa sylvatica</i>).
Chokecherry (<i>Prunus virginiana</i>).	Huckleberry (<i>Gaylussacia</i> sp.).
Black cherry (<i>Prunus serotina</i>).	Black nightshads (<i>Solanum nigrum</i>).
Dwarf sumac (<i>Rhus copallina</i>).	Black elderberry (<i>Sambucus canadensis</i>).
Smooth sumac (<i>Rhus glabra</i>).	Red elderberry (<i>Sambucus pubens</i>).
Poison ivy (<i>Rhus radicans</i>).	Ragweed (<i>Ambrosia</i> sp.).
Fox grape (<i>Vitis vulpina</i>).	

Summary.—No species of woodpecker in this country, with the possible exception of the yellow-bellied sapsucker (*Sphyrapicus varius*), has been the subject of so much adverse criticism as the red-head. It has been accused of eating nearly every variety of cultivated fruit from strawberries to oranges, of pecking corn from the ear, of eating the eggs of poultry and pigeons, of pecking open the skulls and devouring the brains of young poultry, and of destroying the eggs or young of eaves swallows and other birds. These accusations are well grounded, but the habits are probably only local. These reports have been received from hundreds of localities, but in thousands of other places where the bird abounds no such acts have been observed. Stomach examination confirms to some extent the corn-eating habit, and to a less degree the fruit-eating, but fails entirely to show that the bird habitually eats young birds or eggs.¹ Where this bird has done appreciable harm, it has probably been due to new and unusual conditions likely to be temporary. In its animal food the redhead does a little harm theoretically by its destruction of predatory beetles, but the harmful species eaten are enough to balance this. On the whole, there seems to be no reason to condemn this woodpecker except under very unusual conditions, and the man who claims to have killed 527 of them in four years did himself and neighbors a very doubtful service.

¹ Eggshells have been found in some stomachs of nearly every species of bird yet examined by the writer. They are undoubtedly, in most cases, old shells eaten for the lime.

CALIFORNIA WOODPECKER.

(Melanerpes formicivorus bairdi.)

The California woodpecker (Pl. IV) is distributed throughout most of the oak-covered mountain and foothill region of California, northern Lower California, and southern Oregon. It lives generally wherever large oaks are abundant, and from these it gets much of its living. Wherever it occurs it is commonly abundant, and its strongly contrasted colors and loud cries attract much attention as it flies from tree to tree. A peculiar habit has drawn much notice from non-scientific observers—that of drilling holes in tree trunks or large branches, in each of which it places an acorn. Where this bird is abundant all dead trunks or branches of any size, and many live ones, are punctured with these holes, frequently less than an inch apart. So zealous is the bird in this work that often when trees in the proper condition for puncturing are not numerous enough, it attacks buildings and drills holes in the cornices of houses or in the spires of churches; also it bores into telephone and telegraph poles and fence posts, and sometimes uses natural cavities. But the woodpecker does not get the benefit of all the acorns it lays up, for the jays have learned where they can easily obtain food in winter, and are not backward about robbing the woodpecker's larder, thus causing endless quarrels. Probably rats, mice, and squirrels also help themselves to these supplies.

For the laboratory investigation of the food of the California woodpecker 84 stomachs were available. They were taken in every month except February, April, and May—the larger numbers in June and July, when the chances for the bird to do mischief are greatest. The food was found to consist of 22.59 per cent of animal matter to 77.41 per cent of vegetable. This is the highest percentage of vegetable matter yet found in the stomach of any woodpecker, though the red-bellied (*Centurus carolinus*) comes very close to it. Most other woodpeckers eat more animal than vegetable food.

Animal food.—Beetles constitute the smallest item in the animal food. They amount to less than 3 per cent, and are distributed among several families, with no preference shown for any one. In July, the only month in which they are at all prominent, they reach 14.76 per cent. No wood-boring larvæ were found. This seems to indicate that this bird uses its wood-pecking powers, not to find insects, but only to make places for storing food. Ants amount to 8.09 per cent of the food. In one stomach taken in March they constitute 50 per cent of the contents, but in no other do they reach 11 per cent. The specific name of this bird, *formicivorus*, is not well chosen, for it eats fewer ants than most other species of woodpeckers. Other Hymenoptera amount to 7.34 per cent. More than half of these

were contained in stomachs taken in August, when they aggregate 37.33 per cent. A few bugs, flies, and grasshoppers, with some fragments of caterpillars, make up the remainder of the animal food—4.49 per cent. One stomach contained a few black olive scales.

Vegetable food.—Grain, fruit, and mast are the three items that form nearly all the vegetable food. One stomach taken in January contained nothing but corn, and in another collected in December were a few corn hulls. This is the whole of the grain record, and is of no economic interest. The average for the year but slightly exceeds 1 per cent. Fruit amounts to a little less than 23 per cent, and was found in nearly every month in which stomachs were taken. Most of it was evidently the pulp of the larger cultivated varieties, though that found in stomachs collected in the winter months could have no economic value. Seeds of the elderberry (*Sambucus*) were found in two stomachs and were the only fruit positively identified. The largest amounts were eaten in August and September, when they reached 59.34 and 54 per cent, respectively. While this is rather a high percentage of fruit eaten, complaints against the bird are not general, and the damage done to fruit over most of its range is probably comparatively small.

The principal item of the food of the California woodpecker is acorns. This amounts to 53.30 per cent of the food of the year, and was found in 58 stomachs, or 69 per cent of the whole, and 23 contained nothing else. It was eaten in every month when stomachs were taken except August, but as only 3 were collected in that month the record is not reliable. In November, when 12 stomachs were taken, acorns amounted to 93.58 per cent of the average contents. In June, when fruit and insects are abundant, it averaged in 12 stomachs 79.25 per cent. In July the least was eaten—29.47 per cent. This was made up by the animal food, which attained the highest percentage in that month. The question has been raised whether the bird stores the acorn for the sake of its meat or for the grubs which may frequently develop therein. The examination of the stomach contents removes all doubt, for while acorns are eaten freely larvæ are almost entirely wanting.

In certain localities where almonds are largely cultivated and this bird is abundant it exhibits a strong liking for these nuts. Under these conditions it is sometimes necessary to shoot every woodpecker that appears in the orchard in order to save even a reasonable part of the crop. Such conditions are likely to occur wherever large groves of oaks occur in close proximity to the orchards and this bird is correspondingly numerous. While the necessity for applying so drastic a remedy is unfortunate, it can be said that it is not so deplorable as it would be in the case of some other more conspicuously useful species.

Summary.—The foregoing discussion shows that the food of the California woodpecker is not of much economic importance. On the other hand, the bird can not be charged with destroying useful insects or many products of husbandry. While it eats considerable fruit, especially almonds, in fact twice as much as the linnet, it does not habitually infest orchards, and in most localities is not numerous enough to be a serious nuisance. The few insects which it takes are nearly all of harmful species, while the acorns which make up the bulk of its diet may be considered of little value. The trees used for storehouses are usually either dead or partly so, and when alive are little harmed by the punctures, which do not usually go through the bark. When, however, holes are made in buildings, telegraph or telephone poles, or fences, they are a real injury, and it is fortunate that such cases are local and exceptional. From the esthetic point of view, however, a strong plea for the bird's protection may be made. It is an interesting and picturesque species, and where it does not make itself conspicuous by reason of the damage it does it may well be allowed to live.¹

LEWIS WOODPECKER.

(*Asyndesmus lewisi*.)

The Lewis woodpecker (Pl. V) is irregularly distributed over that part of the United States west of the eastern slope of the Rocky Mountains, north to southwestern Canada, and south to northern Mexico. In many localities within its range it is rare or absent, while very abundant in others. It is by nature somewhat shy, not greatly addicted to visiting orchards and cultivated areas.

In Oregon and Washington complaint has been made that the bird does some damage to apples. Only twice was the writer able to find cases of serious damage. An orchard situated close to a river, on the far side of which was a large area of wild land, was so persistently visited by Lewis woodpeckers, when the early apples were ripening, that the pickers were obliged to shoot the birds. One evening a number of boxes filled ready for market were left in the orchard. In the morning it was found that the woodpeckers had pulled out the papers and pecked the fruit so that it was necessary to open and repack several boxes. In the other case the orchard was in the foothills and almost completely surrounded by evergreen forests, from which the birds came and to which they retreated when alarmed.

Dr. Merriam, speaking of Fall River Valley, California, says of this bird: "Common everywhere and eating apples in several of the orchards." Also at Fort Jones: "Evidently eating apples."

¹ Besides the California form, *bairdi*, treated of in these pages, there is at least one other, *aculeata*, within the limits of the United States. Its range is in the southern Rocky Mountains from central western Texas to northern Arizona. No stomachs of this subspecies have been received, but probably its food habits do not differ from those of the other form.

Messrs. Grant and Ferry, writing from Klamath Hot Springs, Oregon, say: "Abundant in flocks first part of September. Persons with guns stationed in orchards * * * to destroy these birds, kill 25 to 50 of them per day for from one to two weeks."

Mr. J. E. McLellam says they "never come in great numbers unless there is a good crop of mast, when they come in swarms. They hoard similar to the California woodpecker." Quite a number of apple growers interviewed by the writer testified that the bird destroyed some apples, but none of them considered the loss of any importance. As the orchards increase in area, the damage will probably become less.

Mr. W. Otto Emerson, of Haywards, Cal., in a letter to the Biological Survey, dated March 14, 1909, says of this bird:

Several cases have come under my observation when in the fall months of September and October the California and Lewis woodpeckers have made their appearance in canyon apple orchards and went into them picking open the apples for the codling moth worms they contained, going all over the trees and taking such fruit as had a wormhole in it. In one orchard of about 2 acres in extent at Sunol, this county (Alameda), near the Niles Canyon, I counted 23 bodies of the Lewis woodpeckers and 9 of the California tied up to the limbs by the legs to frighten off the birds. The owner did not seem to know what the woodpeckers were after * * * till I called his attention to the condition of his wormy fruit.

For investigation of this bird's food only 59 stomachs were available. They were collected in five States from Montana and Wyoming westward to the Pacific coast. They are so irregularly distributed over the year as to make systematic study of the food impossible, but we may learn some of the elements which compose it. Animal matter amounts to 37.48 per cent and vegetable to 62.50 per cent.

Animal food.—Predaceous beetles were eaten to the extent of 6.72 per cent, and, as is usually the case, the most appear to have been taken in spring and early summer. They were made up of Carabidæ and Coccinellidæ (ladybird beetles). Of the former, the genus *Pasimachus* was recognized, and of the latter, two species, *Hippodamia convergens* and *H. 15-maculata*, were identified. Other beetles amount to 2.40 per cent and were all eaten in the five months from June to October. Among them were several Meloidæ, or blister beetles, not usually supposed to be very palatable. One specimen of a water beetle (*Philhydrus diffusus*) was also identified.

There is nothing in the stomachs to indicate that this bird ever digs into wood, decayed or otherwise, in search of beetle larvæ. Ants were eaten most in summer and in April, and June appears to be the month of maximum consumption, while May shows none. The average for the year is 11.87 per cent, but this can not be considered final. Other Hymenoptera reach 11.57 per cent. Hemiptera, or bugs, seem to be taken very sparingly, and those chosen were of the larger species. They amount to 1.36 per cent. Grasshoppers are

eaten—not many in August, more in July, and most in September, with a trace in October, while the eastern birds eat the most of these insects in August. The average for the year is 3.20 per cent. No caterpillars or Lepidoptera in any form were found in this bird's stomach. A few spiders amount to less than half of 1 per cent.

Vegetable food.—Corn was found in one stomach taken in August, and constituted 62 per cent of its contents, but amounted to only 0.46 per cent of the food of the year. No other grain was found. Pulp and skins of fruit supposed to be of cultivated varieties were noted in March, the three summer months, and October. There is no certainty that all this was cultivated fruit, and in any event that taken in March could hardly have had any economic value. The aggregate for the year is 10.90 per cent. Wild fruit was identified in 26 stomachs, all of them taken in July, August, and September. In the former it amounted to over 63 per cent of the food, and the average for the year is 14.65 per cent. Six genera—*Amelanchier*, *Ilex*, *Crataegus*, *Cornus*, *Prunus*, and *Sambucus*—were identified. Mast, or acorns, is the largest item of food. It was found in 20 stomachs and constitutes 34.46 per cent of the diet. None was found in July, but in all the other months in which stomachs were taken it amounted to a good percentage. The one stomach taken in December contained 75 per cent of this food. Seeds of poison oak (*Rhus diversiloba*) and a weed (*Amaranthus*) make up 2.05 per cent, the remainder of the vegetable food.

Summary.—It is hardly possible to draw definite conclusions from so little material, especially when distributed over so large a territory. While the bird eats some useful beetles, probably it does no serious harm in this way. It is not likely to damage grain. Evidently, however, it has a pronounced taste for fruit, which at present is gratified mostly by wild species; but if the wild fruit-bearing shrubs and trees in its range should ever be replaced by cultivated varieties, it would doubtless turn to cultivated fruits. Further investigation in both field and laboratory are necessary in order to fix definitely the economic status of the Lewis woodpecker.

RED-BELLIED WOODPECKER.

(*Centurus carolinus*.)

The red-bellied woodpecker ranges over the eastern United States as far west as central Texas and eastern Colorado, and as far north as New York, southern Ontario, southern Michigan, and southern Minnesota. It breeds throughout this range and appears to be irregularly migratory. Very strangely, it often goes north of its breeding range to spend the winter. Four stomachs, collected in November and December, have been received from Canada, and in eight years of residence in central Iowa the writer found the species

abundant every year during the winter, but never saw one in the breeding season. It is rather more of a forest bird than some of the other woodpeckers, but is seen frequently in open or thinly timbered country. In the northern part of its range it appears to prefer deciduous growth, but in the south is quite common in pine forests.

There is some evidence that this bird is occasionally injurious to the horticulturist. Dr. B. H. Warren says:

In various sections of Florida, where the red-bellied woodpeckers are exceedingly numerous, in fact by odds the most abundant of all the woodpeckers, the common names of "orange sapsucker" and "orange borer" are universally applied to them. On making inquiry of farmers and others, I learned that the names were given because these woodpeckers "sucked the sap" of orange trees and fed on oranges. Supposing these statements were wrongfully made, I at first gave but little attention to them. When, however, I visited Welaka, Palatka, Volusia, Deland, and other places where numerous orange trees were thriving, I was informed by the orange growers that the red-bellied woodpeckers oftentimes destroyed large numbers of oranges when they had matured and were ready for picking; also, that "they damaged the orange trees by boring holes in them and sucking the sap." I had but little opportunity of making a careful study of this orange-eating habit, so greatly talked about, owing to the fact that when I first visited these localities it was late in February, or after the oranges had been picked and shipped north. In the month of March, 1885, I camped a few days at Bluffton, near Volusia, in an orange grove owned by Mr. Bird, of New York City. This grove contained about 30 acres of trees, which were loaded with fruit, then being picked for market. Through the kindness of Mr. Bird and his overseer, Mr. Curtis, I collected 26 red-bellied woodpeckers in this orange grove. Eleven of these birds had fed to a more or less extent on oranges.

Three of the 11 stomachs taken from specimens killed in the forenoon, soon after daylight, contained only orange pulp. Eight stomachs showed, in addition to orange pulp, insects and berries. The stomachs of the remaining 15 birds contained no traces of oranges, but revealed chiefly insects, a few berries, and seeds. I examined two dozen or more oranges which had been attacked by the woodpeckers, and found that all had been bored about midway between the stem and blossom end. These holes, always round, varied greatly in size. The birds usually, I think, pick off the skin from a space about the size of an ordinary 5-cent piece, and then eat out the pulp. In an orchard at Hawkinsville, near Deland Landing, on the St. Johns River, I oftentimes, in the month of April, 1885, found oranges which had been evidently overlooked when the crop was gathered, and in most instances observed that they were bored. In this orchard on one occasion I saw a red-bellied woodpecker eating an orange. He evidently recognized the fact that it was about the last of the season, as he had enlarged the opening sufficiently so that his head was almost entirely hidden in the yellow skin, from the sides of which he picked the few remaining particles of pulp. I was shown orange trees that these "sapsuckers" were said to have bored. These borings, however, did not appear to injure the trees, as they seemed to me to be equally as flourishing as other trees whose trunks showed no marks of a woodpecker's bill.

Mr. William Brewster has made some observations on this point. He says:

As corroborating Dr. Warren's account ¹ in his late report on the birds of Pennsylvania, it may be worth while to state that when at Enterprise, Fla., in February, 1889, I observed a red-bellied woodpecker eating the pulp of a sweet orange. He flew down to the ground and, hopping along rather clumsily, approached an orange, and

¹ Warren, B. H., *Birds of Pennsylvania*, ed. 2, pp. 174-175, 1890.



Rouleyassiz Puertes.

BREUER & KESSLER CO LITH PHILA

FLICKER (ADULT MALE).

for several minutes pecked at it in a slow deliberate way. When I showed myself he at once took flight and sought shelter in the dense foliage of the trees above. Upon examining the orange I found that it was decayed through the whole of one side. In the sound portion were three holes, each nearly as large as a silver dollar, with narrow strips of peel between them. The pulp had been eaten out quite to the middle of the fruit. Small pieces of the rind were thickly strewn about the spot. Upon searching closely I discovered several other oranges that had been attacked in a similar manner. All were partially decayed and were lying on the ground. I was unable to find any on the trees which showed any marks of the woodpecker's bill. The owner of this grove was surprised when I called his attention to the above facts, which were quite new to him. Nor had any of the other orange growers in the neighborhood any knowledge of this orange-eating habit of the red-bellied woodpecker.¹

Mr. Mortimer also gives testimony upon this habit of the bird:

During February and March, 1889, while gathering fruit or pruning orange trees, I frequently found oranges that had been riddled by this woodpecker and repeatedly saw the bird at work. I never observed it feeding upon fallen oranges. It helped itself freely to sound fruit that still hung on the trees, and in some instances I have found 10 or 12 oranges on one tree that had been tapped by it. Where an orange accidentally rested on a branch in such a way as to make the flower end accessible from above or from a horizontal direction the woodpecker chose that spot, as through it he could reach into all the sections of the fruit, and when this was the case there was but one hole in the orange; but usually there were many holes around it. It appeared that having once commenced on an orange the woodpecker returned to the same one repeatedly, until he had completely consumed the pulp, and then he usually attacked another very near to it. Thus I have found certain clusters in which every orange had been bored, while all the others on the tree were untouched. An old orange grower told me that the "sapsuckers," as he called them, never touch any but very ripe oranges and are troublesome only to such growers as reserve their crops for the late market. He also said that it is only within a very few years that they have shown a taste for the fruit, and I myself observed that, although red-bellies were very common in the neighborhood, only an individual, or perhaps a pair, visited any one grove. In one case a pair took up their station in a dead pine near a grove and made excursions after the fruit at all hours of the day, being easily located by the noise they kept up.²

Dr. B. H. Warren states that the stomachs of three red-bellied woodpeckers captured in winter in Chester and Delaware Counties, Pa., contained black beetles, larvæ, fragments of acorns, and a few seeds of wild grapes. The stomachs of eight adults from the St. Johns River, Florida, contained red seeds of two species of palmetto, but no insects. Two additional stomachs from the same locality contained palmetto berries, fragments of crickets (*Nemobius* and *Orocharis saltator*), a palmetto ant (*Camponotus escuriens*), and numerous joints of a myriapod, probably *Julus*.³

Dr. Townend Glover found in the stomach of a red-bellied woodpecker killed in December "pieces of acorns, seeds, and gravel, but no insects. Another, shot in December, contained wing cases of *Buprestis*,

¹ Brewster, William, Auk, VI, 337-338, 1889.

² Mortimer, D. Auk, VII, 339-340, 1890.

³ Birds of Pennsylvania, ed. 2, pp. 174, 178, 1890.

and a species of wasp, or *Polistes*, acorns, seeds, and no bark. A third, shot in May, was filled with seeds, pieces of bark, and insects, among which was an entire *Lachnosterna*, or Maybug.”¹

For the investigation of the food of the red-bellied woodpecker 271 stomachs were available. They were collected in 17 States and Ontario, and represent every month in the year, though but few were taken in June and July. In the first analysis the food was found to consist of 30.94 per cent animal matter to 69.06 of vegetable. The former consists of insects and spiders, with a few tree frogs and lizards, while the latter may be considered as made up of grain, fruit, and mast.

Animal food.—Predatory beetles (Carabidæ) amount to 0.86 per cent, and consist of some of the larger genera like *Pasimachus* and *Calosoma*. They were probably found on the bark of trees. Other beetles, all more or less harmful, aggregate 9.32 per cent of the food. Six species of weevils or snout-beetles were identified, and 14 individuals were taken from one stomach. There were also quite a number of wood-boring larvæ, which the birds must have dug out from the wood, thus benefiting the forest. Beetles form a pretty steady article of diet, and starting with 3.62 per cent in January they increase with fair regularity to May, when they attain the maximum of 27.57 per cent, from which they slowly decrease to 1 per cent in December.

Ants are eaten to the extent of 6.45 per cent of the food and are a fairly constant article of diet. The most are eaten during the warmer months, though none were found in the two stomachs taken in June, which is probably accidental. Evidently this bird does not dig all of the ants it eats from decaying wood, like the downy woodpecker, but, like the flickers, collects them from the ground and the bark of trees. Other Hymenoptera amount to 1.45 per cent, and while these insects are known to be great lovers of warmth and sunshine, most of them are eaten in fall and spring, and many even in winter, when they are usually less numerous. Orthoptera (grasshoppers, crickets, etc.) constitute 5.83 per cent of the food. They were found in 51 stomachs—grasshoppers in 27, eggs of cockroaches in 15, crickets in 8, and a mantis (devil’s rear-horse) in 1. Two stomachs contained the eggs of grasshoppers, which indicates that this bird occasionally forages on the ground. Cockroaches were represented entirely by their egg cases (oötheca). These insects extrude their eggs, not singly like most other creatures, but packed together in a case somewhat like the clip of cartridges used for some modern breech-loading rifles. These cases are probably found by birds in crevices of the bark of trees. Orthoptera are eaten throughout the

¹ United States Agric. Rept. for 1865, p. 38, 1866.

year, but in quantities varying greatly from month to month. In a general way, however, more were eaten in the summer season.

Hemiptera, or bugs, amount to 1.86 per cent of the food, and form a small but fairly regular constituent of the monthly diet. Scales were found in one stomach, but most of the bugs eaten were of larger species, and the majority were Pentatomidæ or stink-bugs. Caterpillars were taken quite regularly, and average 2.88 per cent of the diet. A few of them were identified as wood-borers. Spiders and millepeds, with a few doubtful insects and small vertebrates, make up 2.29 per cent, the remainder of the animal food. Spiders were eaten at all times, but in trifling quantities. Small tree frogs were found in 9 stomachs and remains of a lizard (*Anolis carolinensis*) in 2. One stomach contained the lingual ribbon of a snail.

The following is a list of the insects identified:

COLEOPTERA.

Calosoma wilcoxi.
Pasimachus depressus.
Pasimachus sp.
Catogenus rufus.
Ips fasciatus.
Trogosita virescens.
Melanotus sp.
Passalus cornutus.
Dichelonycha sp.

Lachnosterna sp.
Nodonota puncticollis.
Hylobius pales.
Lixus sp.
Dorytomus mucidus.
Pseudomus truncatus.
Cryptorhynchus obliquus.
Balaninus sp.
Cratoparis lunatus.

HEMIPTERA.

Nezara hilaris.

Vegetable food.—Corn was the only grain found in the food of the red-bellied woodpecker. It was contained in 39 stomachs, rather irregularly distributed through the year, but none in the three summer months, April, or November. The great bulk was eaten in the three winter months and in March and September. In September it was undoubtedly from the green ear in the field, but the rest must have been waste. The total for the year is 3.99 per cent. Fruit amounts to 27.28 per cent and forms a notable percentage of the food in every month. The month of greatest consumption is August, with 64.10 per cent, while April shows the least, 7.50 per cent. The larger part of this consists of wild fruit, of which 23 species were identified. What was thought to be apple pulp was found in one stomach, cultivated grape in one, and blackberry or raspberry in one. Fruit pulp not further identified occurred in 15 stomachs and may have been of cultivated varieties. No great preference is shown for any one species of wild berry, but mulberries, woodbine, fox grapes, and sour gum were found in the most stomachs.

Mast amounts to 30.70 per cent and is the largest item of food. Acorns, beechnuts, hazelnuts, and pecans make up most of this

item. It is eaten throughout the year except during the three summer months. It was found in 178 stomachs, and the greatest consumption appears to be in November, when it reached 67.05 per cent of the month's food, and it does not fall much below this figure until spring. This record for mast eating is the largest of that of any bird of this family except the California woodpecker. In most cases where birds eat much mast they habitually store up nuts and seeds for future use. The writer has been able to find but one reference to such a habit in this bird. W. L. Dawson, in *Birds of Ohio*, page 357, 1903, says it "lays up frugal stores of mast and corn." This seems quite probable, in view of what is found in the stomachs. Poison ivy seeds amount to 2.15 per cent and are eaten in every month from August to February, inclusive.

The following fruits and seeds were found in the stomachs:

Short-leaved pine (<i>Pinus mitis</i>).	Poison ivy (<i>Rhus radicans</i>).
Other pine seeds (<i>Pinus</i> sp.).	American holly (<i>Ilex opaca</i>).
Saw palmetto (<i>Serenoa serrulata</i>).	Swamp holly (<i>Ilex decidua</i>).
Date palm (<i>Serenoa</i> sp.).	Frost grape (<i>Vitis cordifolia</i>).
Greenbrier (<i>Smilax glauca</i>).	Fox grape (<i>Vitis vulpina</i>).
Bristly greenbrier (<i>Smilax bona-nox</i>).	Woodbine (<i>Parthenocissus quinquefolia</i>).
Other greenbrier (<i>Smilax</i> sp.).	Prickly pear (<i>Opuntia</i> sp.).
Bayberry (<i>Myrica carolinensis</i>).	Wild sarsaparilla (<i>Aralia nudicaulis</i>).
Hackberry (<i>Celtis occidentalis</i>).	Flowering dogwood (<i>Cornus florida</i>).
Red mulberry (<i>Morus rubra</i>).	Rough-leaved dogwood (<i>Cornus asperifolia</i>).
Smartweed (<i>Polygonum</i> sp.).	Panicled dogwood (<i>Cornus candidissima</i>).
Pokeberry (<i>Phytolacca decandra</i>).	Sour gum (<i>Nyssa sylvatica</i>).
Sassafras (<i>Sassafras sassafras</i>).	Huckleberry (<i>Vaccinium</i> sp.).
Blackberry or raspberry (<i>Rubus</i> sp.).	Elderberry (<i>Sambucus canadensis</i>).
Wild black cherry (<i>Prunus serotina</i>).	Ragweed (<i>Ambrosia</i> sp.).
Sumac (<i>Rhus glabra</i>).	

Summary.—Only one element in the food of the red-bellied woodpecker has much economic significance. The bird evinces a decided taste for fruit, and sometimes injures orchards, as in Florida orange groves. The contents of the stomachs, however, show that wild fruits are the favorites, and probably only when these have been replaced by cultivated ones is any mischief done. Orange pulp was not positively identified in any stomach, though quite a number were collected in Florida during the orange season. Only a little of the grain eaten is taken when it is a loss to the farmer. In its animal food the bird is almost entirely beneficial, as the insects eaten are largely noxious.

FLICKER.

(*Colaptes auratus* subsp.)

The flicker (Pl. VI), known also as the golden-winged woodpecker, yellow-shafted woodpecker, high-holder, yellow-hammer, pigeon woodpecker, and hairy-wicket, is one of the most widely distributed and best known species in the United States. This is one of the few

woodpeckers whose flesh is considered palatable, and a few years ago large numbers were shot for market every fall when wild black cherries were ripe. The bird is so fond of this fruit that when feeding in the trees it loses its natural shyness and is easily approached and killed. Fortunately it is now protected by law in most of the States, and it should be in all. It is a bird of the open country rather than of the forest. It is much more wary than the hairy or downy. It visits the orchard regularly, but does not make serious inroads on the fruit, and it forages much upon the ground—in fact, in spite of its liking for tall trees, the flicker is the most terrestrial of American woodpeckers.

This species is distributed over the whole of the eastern United States and north to Canada and Alaska, and is replaced in the West by the red-shafted flicker. The two forms meet on the Great Plains and along the eastern edge of the Rocky Mountain region and intermingle in all degrees of hybridism. Typical specimens of either species are frequently taken far within the range of the other, as, for instance, a perfect *Colaptes auratus* was collected by the writer a few miles east of Haywards, Cal., while typical *C. cafer collaris* can be taken every winter at Ames, Iowa. With the possible exception of the yellow-bellied woodpecker, the eastern flicker is the most migratory American species. In winter it is rarely seen in New England and only in small numbers in the other northern States. As it breeds abundantly in Canada, it becomes very numerous in the northern tier of States in fall when migrating. At this time it subsists largely upon wild cherries and other wild fruits.

The flicker rears from 6 to 10 young in each brood. The nest is built in a cavity-excavated in a partially decayed tree, and is often quite elaborate, but in some cases it is in a hole caused by natural decay, where little or no preparatory work is required. The young find their voices very early in life, and by the time they are a week old make a great outcry every time they receive a visit from their parents or even hear approaching footsteps.

Complaints have been made that the flicker eats corn and cultivated fruit to an injurious extent, but the charges are not very specific, and the stomach contents do not indicate extensive depredations of this kind.

For the investigation of the food of the eastern flicker, 684 stomachs were available. They were collected in 35 States, the District of Columbia, and Canada, and are very evenly distributed through the year. The food consists of 60.92 per cent of animal matter to 39.08 of vegetable. In addition the stomachs contain considerable fine sand, which is probably not taken to aid digestion, but is swallowed accidentally with some kinds of food, notably ants. Quite a quantity of vegetable rubbish is taken in the same way.

Animal food.—Predaceous ground beetles (Carabidæ) form a small but very constant element of the flicker's food. Among those eaten are some of the larger and more predatory genera, such as *Calosoma*, *Scarites*, and *Pterostichus*. The total amount eaten in the year is only 1.62 per cent of the food, and in August, the month of greatest consumption, it rises to only 3.79 per cent. Other beetles are found in the food of every month, but in rather irregular amounts. The aggregate for the year is 3.52 per cent. The favorite food of the flicker, however, is ants. They form the largest item of animal food, not only in the aggregate but in every month. The total for the year is 49.75 per cent of the food. They were found in 524 of the 684 stomachs, i. e., in 76 per cent of the whole, and there were 98 stomachs that contained no other food. The following table shows the importance of ants in the diet of the flicker:

Months.	Number of stomachs.	Per cent of ants in food.	Number of stomachs with ants.	Per cent of stomachs with ants.	Number with no other food.
January.....	34	24.09	20	58.8	
February.....	55	29.73	31	56.3	4
March.....	37	79.14	32	86.5	14
April.....	75	80.17	70	93.3	21
May.....	33	79.24	32	96.9	9
June.....	31	79.19	30	96.8	9
July.....	51	70.74	47	92.1	13
August.....	92	61.47	84	91.3	12
September.....	138	42.61	108	76.1	12
October.....	54	21.79	31	57.4	2
November.....	41	17.37	22	53.6	1
December.....	43	11.46	17	39.5	1
Total.....	684		524		98
Average per month.....		49.75		74.9	

In one case a stomach and crop were both filled with very small ants (*Cremastogaster* sp.). The whole mass was divided with care into 16 parts as nearly equal as possible, and in one part 315 ants were counted, giving 5,040 in one meal of one flicker. In addition there were at least 100 pupæ. Two other stomachs and crops examined in the same way each gave a little over 3,000 ants. Probably each of 100 stomachs in the collection contained nearly as much ant food as these, but the number of ants was less because they were of larger species. A large proportion of the ants eaten are of species that live in the earth, and these appear to be the principal food the flicker obtains on the ground. In every case where the stomach held a quantity of these small ants, a lot of fine sand revealed their source.

Since the flicker destroys so many ants, it may be well to inquire as to the economic bearing of this work. As a rule we do not hear many serious complaints against ants. They do not attack crops or manufactured products. Probably they do some good by devouring dead matter, both animal and vegetable, and in this way hasten the decay of dead trees. On the other hand, some species enter

houses and become a positive nuisance, as, having their nest in an inaccessible place, it is almost impossible to destroy them. Other species establish colonies in lawns or gardens and are so persistent that nothing short of digging out and carrying off the whole area of earth which they have preempted will rout them from their chosen home. When timber has been injured by wood-boring beetle larvæ, ants enlarge the burrows and in a few years riddle and spoil the whole trunk. The worst sin of the ants, however, is that they protect and foster plant lice in every possible way. They defend them from their enemies, cover them with sheds to shield them from inclement weather, and upon the approach of winter they carry some species into the ground and place them on the roots of plants for the winter and at the return of warm weather bring them to the upper air and place them in a position suitable to their needs. As plant lice constitute one of the worst pests to horticulture, their protectors are a nuisance and should be destroyed. As we have seen, flickers devour enormous numbers of them and aid essentially in holding them in check. Hymenoptera other than ants amount to only four one-hundredths of 1 per cent of the yearly food.

Bugs (Hemiptera) are eaten in nearly every month, but only in small quantities. In January, February, and May they reach an average of about 3 per cent, but in no other month do they amount to even 1 per cent. One stomach contained scales not further identified, another held 17 chinch bugs (*Blissus leucopterus*), and in another were what were probably the same in an early stage of growth. Two stomachs contained each a single bedbug (*Cimex lectularius*), probably taken on trial and not relished. Cicadas, or harvest flies (*Tibicen rimosa*), were found in several stomachs. The aggregate of Hemiptera for the year is only 0.85 per cent.

Orthoptera, in the shape of grasshoppers, crickets, and cockroaches, amount to 2.39 per cent. They are eaten in every month, but not very regularly. Singularly, the maximum quantity was taken in January, 9.77 per cent, which is more than twice the amount in any other month. This record, however, was made by birds taken in Texas, which had partaken freely of crickets. The least consumption occurs in August, the grasshopper month, which shows that the flicker is not a lover of grasshoppers.

Lepidoptera, in the form of caterpillars, are eaten very sparingly—in fact in only three months do they amount to as much as 1 per cent. In August they reach 4.91 per cent, 3.13 in June, and 3.29 in November. The only one identified was the common zebra caterpillar of the gardens (*Mamestra picta*). The total for the year is 1.28 per cent. A few fly larvæ, spiders, myriapods, crustaceans, and snails make up the rest of the animal food. Larvæ of Tipulidæ (crane flies) were found in 3 stomachs and *Bibio* larvæ (March flies) in 2. As

these creatures breed in the earth, this again shows the terrestrial habits of the flicker. Spiders and myriapods were found in a good many stomachs, but few were taken at one time, so the aggregate is not large. Crustaceans, in the form of *Oniscus* (sowbugs), were found in 5 stomachs. Snail shells, mostly fragments, were of frequent occurrence, and one was identified as *Zonitoides minusculus*. The total of these miscellaneous creatures is 1.49 per cent; which completes the record of animal food.

The following is a list of the insects identified in the stomachs:

COLEOPTERA.

<i>Cicindela vulgaris</i> .	<i>Quedius prostrans</i> .
<i>Calosoma calidum</i> .	<i>Stelidota 8-maculata</i> .
<i>Elaphrus oblitteratus</i> .	<i>Melanotus communis</i> .
<i>Scarites subterraneus</i> .	<i>Copris minutus</i> .
<i>Pterostichus sayi</i> .	<i>Onthophagus hecate</i> .
<i>Amara exarata</i> .	<i>Onthophagus</i> sp.
<i>Amara impuncticollis</i> .	<i>Aphodius fimetarius</i> .
<i>Amara angulata</i> .	<i>Aphodius inquinatus</i> .
<i>Calathus ingratus</i> .	<i>Aphodius bicolor</i> .
<i>Platynus placidus</i> .	<i>Aphodius</i> sp.
<i>Platynus punctiformis</i> .	<i>Lachnosterna</i> sp.
<i>Brachynus puberulus</i> .	<i>Ligyris</i> sp.
<i>Chlænium</i> sp.	<i>Caryoborus arthriticus</i> .
<i>Agonoderus pallipes</i> .	<i>Opatrinus aciculatus</i> .
<i>Harpalus faunus</i> .	<i>Blapstinus pruinatus</i> .
<i>Harpalus pennsylvanicus</i> .	<i>Blapstinus pulverulentus</i> .
<i>Harpalus pleuriticus</i> .	<i>Blapstinus</i> sp.
<i>Harpalus ellipsis</i> .	<i>Tanymecus confertus</i> .
<i>Anisodactylus rusticus</i> .	<i>Sitones hispidulus</i> .
<i>Anisodactylus</i> sp.	<i>Phytonomus punctatus</i> .
<i>Stenus shoshonis</i> .	<i>Sphenophorus</i> sp.

HYMENOPTERA (ANTS).

<i>Formica obscuripes</i> .	<i>Camponotus minutus</i> .
<i>Formica nitidiventris</i> .	<i>Camponotus pictus</i> .
<i>Formica subsericea</i> .	<i>Camponotus</i> sp.
<i>Formica subpolita</i> .	<i>Myrmica scabrinodis</i> .
<i>Formica gagates</i> .	<i>Myrmica sabuleti</i> .
<i>Formica subænescens</i> .	<i>Myrmica</i> sp.
<i>Formica</i> sp.	<i>Cremastogaster læviuscula</i> .
<i>Lasius claviger</i> .	<i>Cremastogaster minutissimus</i> .
<i>Lasius aphidicola</i> .	<i>Cremastogaster</i> sp.
<i>Lasius brevicornis</i> .	<i>Aphænogaster picea</i> .
<i>Lasius americanus</i> .	<i>Aphænogaster fulvum</i> .
<i>Lasius alienus</i> .	<i>Aphænogaster treatæ</i> .
<i>Lasius miniatus</i> .	<i>Aphænogaster</i> sp.
<i>Lasius subniger</i> .	<i>Prenolepis imparis</i> .
<i>Lasius</i> sp.	<i>Pheidole</i> sp.
<i>Camponotus marginatus</i> .	<i>Solenopsis geminata</i> .
<i>Camponotus melleus</i> .	<i>Solenopsis debilis</i> .
<i>Camponotus pennsylvanicus</i> .	<i>Tetramorium</i> sp.

HEMIPTERA.

Zelus renardi.
Blissus leucopterus.
Metapodius sp.

Tibicen rimosa.
Cimex lectularius.

DIPTERA.

Bibio sp.

Tipula sp.

LEPIDOPTERA.

Mamestra picta.

ORTHOPTERA.

Gryllus sp.

Ischnoptera sp.

ISOPTERA.

Termes flavipes.

CRUSTACEA.

Oniscus sp.

MOLLUSCA.

Parastarte triquetra.

Zonitoides minusculus.

Vegetable food.—Corn was found in 17 stomachs of the flicker, wheat in one, and buckwheat in two. One stomach taken in March was entirely filled with corn, evidently waste grain. Most of the remainder was taken in fall and early winter. The total for the year is 1.12 per cent. Small fruits are the favorite vegetable food with this bird. They are eaten in every month and constitute a good percentage in all but two. In April and May fruit amounts to less than 1 per cent, but increases through the summer to October, when it is about 42 per cent of the food, and then decreases gradually to the minimum in April. Possibly some of the *Rubus* fruits were cultivated, and the cherries in one stomach certainly were, while the fruit pulp in 21 stomachs may have been, but in any case the amount is insignificant and shows that the flicker eats but little domestic fruit. On the other hand, 31 species of wild fruits were identified. They were contained in 265 stomachs, and 40 contained no other food. They are not only the favorite vegetable food, but, next to ants, are the favorite food of the year. There is also shown a fondness for the seeds of various species of poisonous *Rhus* (poison ivy, poison oak, and poison sumac). These seeds are eaten mostly in the fall and winter months, when small fruits are less abundant. May, June, and July are the only months when none were eaten. November appears to be the month of greatest consumption, when they reach nearly 38 per cent. The aggregate for the year is 9.25 per cent.

Mast, if the term be limited to acorns and other nuts, is not a favorite food of the flicker. It is eaten to some extent in the three

winter months and occasionally tasted at other times. It amounts to 1.79 per cent of the food. Cambium, weed seed, nonpoisonous *Rhus* seeds, and rubbish are found in some stomachs pretty regularly through the year, though the quantity is very irregular. It would appear that the three former are eaten only in default of anything better, and the last is probably taken accidentally when seeking ants in rotten wood or under rubbish. The total amount is 6.64 per cent and completes the quota of vegetable food.

The following fruits and seeds were identified:

	Number of stomachs containing		Number of stomachs containing
Hemlock (foliage) (<i>Tsuga canadensis</i>).....	1	White clover (<i>Trifolium repens</i>).....	6
Red cedar (<i>Juniperus virginiana</i>)....	5	Crane's-bill (<i>Geranium</i> sp.).....	1
Barnyard grass (<i>Panicum</i> sp.).....	1	Croton (<i>Croton</i> sp.).....	1
Foxtail grass (<i>Ixophorus</i> sp.).....	2	Dwarf sumac (<i>Rhus copallina</i>).....	3
Glaucous-leaved greenbrier (<i>Smilax</i> <i>glauca</i>).....	1	Smooth sumac (<i>Rhus glabra</i>).....	11
Cat brier (<i>Smilax rotundifolia</i>).....	1	Poison sumac (<i>Rhus vernix</i>).....	5
Bristly greenbrier (<i>Smilax bona-nox</i>)..	1	Poison ivy (<i>Rhus radicans</i>).....	82
Laurel-leaved brier (<i>Smilax lauri-</i> <i>folia</i>).....	3	Poison oak (<i>Rhus diversiloba</i>).....	1
Bayberry (<i>Myrica carolinensis</i>).....	48	Sumac (<i>Rhus</i> sp.).....	11
Sweet fern (<i>Comptonia peregrina</i>)....	1	American holly (<i>Ilex opaca</i>).....	1
Beech (<i>Fagus americana</i>).....	1	Dahoon holly (<i>Ilex cassine</i>).....	1
Hackberry (<i>Celtis occidentalis</i>).....	24	Ink berry (<i>Ilex glabra</i>).....	8
Mulberry (<i>Morus rubra</i>).....	2	Swamp holly (<i>Ilex decidua</i>).....	1
Pale persicaria (<i>Polygonum lapathi-</i> <i>folium</i>).....	1	Black alder (<i>Ilex verticillata</i>).....	4
Lady's thumb (<i>Polygonum persi-</i> <i>caria</i>).....	1	Burning bush (<i>Euonymus</i> sp.).....	1
Black bindweed (<i>Polygonum convol-</i> <i>vulus</i>).....	1	Frost grape (<i>Vitis cordifolia</i>).....	22
Smartweed (<i>Polygonum</i> sp.).....	4	Flowering dogwood (<i>Cornus florida</i>)..	16
Pokeweed (<i>Phytolacca decandra</i>).....	5	Rough-leaved dogwood (<i>Cornus as-</i> <i>perifolia</i>).....	1
Magnolia (<i>Magnolia foetida</i>).....	3	Alternate-leaved dogwood (<i>Cornus</i> <i>alternifolia</i>).....	1
Spicebush (<i>Benzoin benzoin</i>).....	2	Sour gum (<i>Nyssa sylvatica</i>).....	32
Sand blackberry (<i>Rubus cuneifolius</i>)..	1	Large tupelo (<i>Nyssa aquatica</i>).....	2
Blackberry or raspberry (<i>Rubus</i> sp.)..	15	Huckleberry (<i>Gaylussacia</i> sp.).....	6
Juneberry (<i>Amelanchier canadensis</i>)..	3	Blueberry (<i>Vaccinium</i> sp.).....	7
Wild black cherry (<i>Prunus serotina</i>)..	30	Black nightshade (<i>Solanum nigrum</i>)..	1
Chokecherry (<i>Prunus virginiana</i>)....	7	Mullein (<i>Verbascum thapsus</i>).....	1
Crab cherry (<i>Prunus avium</i>).....	1	Black elderberry (<i>Sambucus canaden-</i> <i>sis</i>).....	11
		Red elderberry (<i>Sambucus pubens</i>)..	1
		Ragweed (<i>Ambrosia artemisiifolia</i>)..	3

Summary.—From the point of view of the food analyst the farmer and horticulturist have very little quarrel with the flicker. It eats only a few predaceous ground beetles. The remainder of the animal food is entirely of harmful species. In its vegetable diet, grain and fruit are the only useful products eaten, and the quantities are insignificant. The bird, like many others, has the bad habit of sowing broadcast the seeds of the poison *Rhus*, but there seems no remedy for this.

RED-SHAFTED FLICKER.

(*Colaptes cafer collaris* and other subspp.)

The red-shafted flicker inhabits that part of North America westward from the Great Plains, where its range meets that of the golden-winged woodpecker. Typical specimens of *Colaptes cafer collaris* are found as far east as South Dakota, central Iowa, and central Texas. The writer took them in winter at Ames, Iowa, for several years in succession. The eastern and western forms of the flicker nest in the same kind of places, their voices and manner of flight are the same, as are their methods of feeding, and practically their food. The differences of plumage can be certainly distinguished only when the bird is near. The western species has one habit which the eastern one rarely shares, that of pecking holes in cornices and cupolas in order to prepare a winter home. As most of the eastern flickers migrate in winter, the few that remain usually find lodging places in trees. In California, where the birds do not migrate in winter, much complaint has been made against them for disfiguring and injuring buildings.

For the investigation of the food of the red-shafted flicker 183 stomachs were available. They were collected in 10 States and in British Columbia, but more than three-fourths of them came from California. They are distributed through every month of the year, but the warmer seasons are represented by entirely too few. The food was found to consist of 67.74 per cent of animal matter to 32.26 of vegetable. This is over 6 per cent more animal food than is eaten by the eastern species. This difference occurs almost entirely in the winter months, when, in the East, the ground is more or less covered with snow and insects are not readily obtained, while seeds and berries are still accessible.

Animal food.—Useful Coleoptera, i. e., predaceous ground beetles, amount to 3.89 per cent of the food, but appear to be eaten very irregularly. In January and March they amount to 17 per cent of the food and in November to 7.28 per cent. In two months they barely reach 1 per cent, and in all the others they are but a trace or do not appear at all. This would seem to indicate that these insects are taken only when better food is not at hand. Other beetles amount to 2.66 per cent. They are largely Scarabæidæ or May beetles, most of them in the larval stage. The larvæ live to a great extent in rotten wood and rubbish, and some species that live on plant roots are often turned up by the plow. They seem to form quite a constant element of the food of both species of flicker. Ants are the favorite food of this bird as well as of its eastern relative. They aggregate 53.82 per cent of the food, which is more than 4 per cent higher than the record of *auratus*, though it is doubtful if this

difference would hold with a larger number of stomachs. In May only one stomach of *cafer* was taken, and it was entirely filled with ants. Like those eaten by *auratus*, these ants are to a great extent taken from the ground, and the usual quantity of sand was found with them. Ants were found in 127 of the 183 stomachs, and 23 contained no other food. Besides the sand ants, some of the large species that live in decaying trees and logs were eaten. These of course are dug out of their burrows. Hymenoptera other than ants are eaten by this bird so rarely as to be negligible.

Hemiptera, or bugs, constitute 1.84 per cent of the flicker's diet, but they are so far from being a favorite food that they were found in the stomachs collected in only 4 months—January with 1.92 per cent, April with 12.50 per cent, June with 7.50 per cent, and October with 0.14 per cent. In each of these months the insects were contained in only one stomach and in April and June were all cicadas, or harvest flies, but in the January stomach they consisted of those curious and delicate looking creatures called lace bugs (*Tingitidæ*). Caterpillars amount to 2.12 per cent of the food and are mostly eaten in the winter and spring months. This is probably owing to the fact that the species taken are mostly wood borers and are dug out of decaying wood in the colder season. March is the month of greatest consumption with 9.11 per cent, and December next with 8.84 per cent. The amount in the other months is small.

Orthoptera aggregate 1.45 per cent and consist of crickets with a few bits of grasshoppers and locusts. They are all taken from October to February inclusive, which shows that this bird, although so terrestrial in its habits, does not join in the grasshopper feast in summer. White ants (*Termes*), a few other insects, and spiders collectively amount to 1.96 per cent and complete the animal food. *Termes* are very similar in habits to the true ants, and are often found and devoured by woodpeckers in their search for ants. Like true ants, white ants do much mischief by boring into timber, and are not infrequently found in the woodwork of buildings, which they sometimes greatly injure, even to the extent of threatening the stability of the structure.

The following insects were identified in the stomachs:

COLEOPTERA.

Pterostichus permundus.
Evarthrus orbatus.
Amara insignis.
Calathus ruficollis.
Platynus maculicollis.
Axinopalpus biplagiatus.
Harpalus herbivagus.

Harpalus sp.
Anisodactylus dilatatus.
Anisodactylus piceus.
Cheridium histeroides.
Diabrotica soror.
Anthonomus sp.
Calandrinus grandicollis.

HYMENOPTERA (ANTS).

<i>Formica subpolita.</i>	<i>Cremastogaster lincolata.</i>
<i>Formica neorufibarbis.</i>	<i>Cremastogaster</i> sp.
<i>Formica obscuriventris.</i>	<i>Solenopsis geminata.</i>
<i>Formica obscuripes.</i>	<i>Prenolepis imparis.</i>
<i>Formica</i> sp.	<i>Myrmica lobicornis.</i>
<i>Camponotus marginatus.</i>	<i>Myrmica</i> sp.
<i>Lasius americanus.</i>	<i>Messor andrei.</i>
<i>Lasius</i> sp.	

CRUSTACEA.

Sowbug (*Porcellio scaber*).

MOLLUSCA.

Snail (*Lymnaea columella*).

Vegetable food.—Fruit was eaten to the extent of 10.28 per cent of the red-shafted flicker's food. It appears to be taken rather irregularly, but probably examination of a greater number of stomachs would show it to be a pretty regular article of diet, as the eastern flicker is a constant fruit eater. The greatest amount is taken in November, when it aggregated 31.84 per cent. September stands next with 23.75 per cent. Like the eastern species, this bird eats more fruit in fall and winter than in the warmer months. Grapes were identified in 12 stomachs, and probably nearly all were of cultivated varieties. Domestic cherries were found in one stomach, what was thought to be apple pulp in 9, and fruit pulp not further identified in 11. This is the whole list of cultivated fruit, if we suppose the last item to have been of domestic varieties, but as the greater part of it was taken in the winter or late fall months, probably little harm was done. Wild fruits of 6 varieties were found in 10 stomachs. There appear to be less small fruits or berries available for bird food on the western side of the Rocky Mountains than on the eastern. This is well illustrated in the diet of the two flickers; the eastern species has 31 kinds of wild fruit in its bill of fare to 6 of the western bird. This difference has been noted in the food of other closely allied species, one from the East and the other from the West.

Grain amounts to 2.26 per cent of the food. It was found in January, August, October, and November, and consisted of corn in 14 stomachs, barley in 1, and oats in 1. The barley and oats were taken in January, and were therefore waste grain. The corn must have been obtained from the standing crop, and indeed much of it had been eaten while in the milk. This is not, however, a heavy indictment against the flicker and may well be excused. Seeds of various shrubs and herbs and some rubbish amount to 19.59 per cent, and make up the quota of vegetable food. The largest part of this item consists of seeds of the different poisonous *Rhuses*, commonly

known as poison ivy or poison oak. They are probably eaten in every month, though the one stomach taken in May did not contain any. They were found in 51 stomachs and formed a staple article of diet in all the cooler months, and in December amounted to more than half the food. It is in the distribution of these seeds, if anywhere, that the flickers do harm. Seeds of the nonpoisonous Rhuses (sumac) and of various weeds were eaten occasionally but not in great quantities. Mast in the shape of acorns was found in 16 stomachs, and is probably very acceptable in the absence of better food.

The following fruits and seeds were identified:

Pigweed (<i>Amaranthus</i> sp.).	Sumac (<i>Rhus</i> sp.).
Purslane (<i>Portulaca</i> sp.).	Pepper berry (<i>Schinus molle</i>).
Gooseberry (<i>Ribes menziesi</i>).	Woodbine (<i>Parthenocissus quinquefolia</i>).
Bur clover (<i>Medicago denticulatum</i>).	Dogwood (<i>Cornus pubescens</i>).
Filaree (<i>Erodium cicutarium</i>).	Elder (<i>Sambucus glauca</i>).
Poison ivy (<i>Rhus radicans</i>).	Sunflower (<i>Helianthus</i> sp.).
Poison ivy (<i>Rhus aromatica</i>).	Star thistle (<i>Centaurea calcitrapa</i>).
Poison oak (<i>Rhus diversiloba</i>).	Bur thistle (<i>Centaurea melitensis</i>).

Summary.—The above analysis of the food shows that the farmer and horticulturist have little to fear from the red-shafted flicker. In its animal diet it does very little harm, and it consumes no more of the products of husbandry than it is entitled to. Its greatest fault is distributing seeds of the poisonous Rhuses, a sin which it shares with so many other birds that there is no occasion for invidious comparisons.

IVORY-BILLED WOODPECKER.

(*Campephilus principalis*.)

The ivory-billed is the largest woodpecker inhabiting the United States. Unfortunately, it appears to be rapidly becoming extinct. It originally occupied all the heavily wooded bottom lands from eastern Texas east to the Atlantic and from southern Indiana and Illinois south to the Gulf. At present it is confined to the lower Mississippi Valley and Gulf States and is nowhere numerous.

Only two stomachs of this species have been available for examination. The contents of these are discussed in detail because of the interest that attached to this magnificent but vanishing bird rather than its present economic importance. One stomach contained 32 and the other 20 of the wood-boring cerambycid larvæ, which live by boring into trees. These constituted 37.5 per cent of the whole food. The remainder of the animal food consisted of engraver beetles (*Scolytidæ*) found in one stomach. Of these, three species were identified—*Tomicus avulsus*, *T. calligraphus*, and *T. grandicollis*. The total animal food amounted to 38.5 per cent.

The vegetable food consisted of fruit of *Magnolia foetida* in one stomach, and of pecan nuts in the other. The average for the two was 61.5 per cent. This analysis of food indicates that the species, except for its small numbers, might be of considerable economic value, as the insects forming the animal portion of the food are mostly of an injurious character. These powerful birds are able to reach the wood-boring grubs in places where smaller species fail, and their large bodies require a great quantity of such food. The vegetable portion of the food does not indicate that the bird is likely to attack any products of agriculture, an inference which is strengthened by its shy, retiring habits. It is preeminently a wilderness lover and avoids cleared and cultivated districts.

When we see how much good this woodpecker is capable of doing as a guardian of the forest, it seems deplorable that it should be allowed to be exterminated. Wise legislation, backed by intelligent public opinion, may retard, if not absolutely prevent, the present destruction and allow the bird to regain something of its former abundance. There is plenty of room for this splendid species and much need of its services in the great southern forests.

OTHER WOODPECKERS.

Besides the species of woodpeckers whose food has been discussed in the preceding pages, a few stomachs of 5 other species have been received, and, while there are too few to warrant a general discussion of their food, some mention of its most prominent characteristics may be made. The following table gives the number of stomachs of each species and the percentage of animal and vegetable food for each:

Name of species.	Number of stomachs.	Animal food.	Vegetable food.
Texan woodpecker (<i>Dryobates scalaris bairdi</i>).....	14	92.07	7.93
White-headed woodpecker (<i>Xenopicus albolarvatus</i>).....	14	38.93	61.07
Golden-fronted woodpecker (<i>Centurus aurifrons</i>).....	11	54.73	45.27
Gila woodpecker (<i>Centurus uropygialis</i>).....	1	40.00	60.00
Gilded flicker (<i>Colaptes chrysoides</i>).....	5	88.00	12.00

The Texan woodpecker (*Dryobates s. bairdi*) shows the ruling characteristic of the genus in its food, for the largest item is wood-boring beetle larvæ. Caterpillars are second in importance, and include a number of cotton worms (*Alabama argillacea*), which were found in some stomachs collected in Texas. Ants are next in rank, and these three items make up the bulk of the food.

Half of the animal food of the white-headed woodpecker (*Xenopicus albolarvatus*) is ants, but the most pronounced characteristic of this bird is its fondness for the seeds of pines, which constitute more than half of the food.

The golden-fronted woodpecker (*Centurus aurifrons*) shows a decided taste for grasshoppers, which make up half of its animal food. Its vegetable diet is composed almost entirely of small fruits or berries.

The one stomach of the Gila woodpecker (*Centurus uropygialis*) was largely filled with beetles of the May-beetle family, with a few bones of a lizard. The vegetable part was mere refuse.

The gilded flicker (*Colaptes chrysoides*) shares the characteristic fondness of the genus for ants, which constitute three-fourths of the whole food. The vegetable part was mostly mast.



- B -

DOES IT PAY THE FARMER TO PROTECT BIRDS?

By

H. W. HENSHAW,

Administrative Assistant, Biological Survey.

[REPRINT FROM YEARBOOK OF DEPARTMENT OF AGRICULTURE FOR 1907.]

CONTENTS.

	Page.
Insectivorous birds and their food habits.....	166
Vegetarian birds and their food habits.....	170
Protection of birds from man.....	176
Means of attracting birds to the farm	177
Means of protecting crops from birds.....	177
Farmers' gain from protecting birds	178

ILLUSTRATIONS.

	Page.
PLATE VI. A useful insect eater—Kentucky warbler.....	168
VII. One of our forest conservators—Red-bellied nuthatch	168
VIII. A valuable bird in danger of extinction—Field plover.....	172
IX. A typical seed eater—White-throated sparrow.....	172

DOES IT PAY THE FARMER TO PROTECT BIRDS?

By H. W. HENSHAW,

Administrative Assistant, Biological Survey.

As objects of human care and interest birds occupy a place filled by no other living things, and the various movements to protect and foster them would be fully justified were there no returns other than esthetic. Only the thoughtless and the ignorant still hold that the graceful forms and beautiful plumage of these masterpieces of nature serve their highest purpose when worn on a hat for a brief season, to be then cast aside and forgotten, the plumage dimmed and faded, the beautiful songs quenched forever.

While by no means insensible to the higher value of birds, the farmer who is asked to aid in measures for their protection is entitled to inquire as to the practical purpose they subserve and how far they may be expected to return his outlay of time, trouble, and expense.

Since most birds eat insects and since many eat practically nothing else, it is their insect-eating habits that chiefly invite inquiry, for so active and persistent are birds in the pursuit of insects that they constitute their most important enemies.

When birds are permitted to labor undisturbed they thoroughly police both earth and air. The thrushes, sparrows, larks, and wrens search the surface of the earth for insects and their larvæ or hunt among the leaves and peer under logs and refuse for them. The warblers, vireos, creepers, and nuthatches with their microscopic eyes scan every part of the tree or shrub—trunk, branches, and leaves—and few hidden creatures escape them. The woodpeckers, not content with carefully scrutinizing the bark and limbs of trees, dig into decayed and worm-eaten wood and drag forth the burrowing larvæ, which in their hidden retreats are safe from other enemies. The flycatchers, aided by the warblers, are ever on the alert to snap up insects when flying among trees and branches; while the swallows and nighthawks skim over the pastures and patrol the air high above the tree tops for such of the enemy as have escaped pursuit below. Thus each family plays its part in the never-ending warfare, and the number of insects annually consumed by the combined hosts is simply incalculable. It is well that this is so, for so vast is the number of insects and so great is the quantity of vegetation required for their subsistence that the existence of every green thing would be

threatened were it not for birds and other agents specially designed to keep them in check.

While birds are not numerous in the sense that insects are, they exist in fair numbers everywhere—or would were it not for the interference of man—and so rapid is the digestion of birds and so perfect their assimilative powers that, to satisfy the appetite of even a small bird, great numbers of insects are needed. Much of this food is hidden and must be searched for; much of it is active and must be vigorously pursued. Hence only by the expenditure of much time and labor do birds procure their daily food. With birds the struggle for existence is peculiarly a struggle for subsistence; shelter is obtained with comparative ease, and if climatic conditions are not to their liking they migrate to other regions.

When by reason of favorable conditions insects have multiplied and become unusually abundant, birds eat much more than at ordinary times; hence the importance of their services during insect invasions. It is not, however, at such periods that their services are most valuable. It is their persistent activity in destroying insects every day, at all seasons, and in every stage of growth—the long, steady pull rather than the spasmodic effort—that tends to prevent insect irruptions and to keep the balance true.

Few birds are wholly beneficial, and there are very few among the harmful ones that have no redeeming traits—that do not, occasionally at least, do good. Most birds most of the time are beneficial; a few birds most of the time are injurious. Certain species may be beneficial in one region and harmful in others, or perform useful services at one season and be injurious at another. Instead, therefore, of being simple, as at first sight they may appear, the relations of birds to man are complex. That the exact nature of the services they render may be better understood, the food habits of certain of the more prominent ones will be briefly reviewed.

INSECTIVOROUS BIRDS AND THEIR FOOD HABITS.

HAWKS AND OWLS.—The strong beaks and sharp talons of the hawks and owls at first sight might be thought designed for more serious work than the destruction of insects, and yet many of the birds of prey make insects an important part of their food. The little sparrow hawk lives largely upon grasshoppers and crickets, and some, even of the larger species, as the Swainson hawk of the Western States, in summer time live almost exclusively upon them. It is very fortunate that so many birds—the hawks among them—are fond of grasshoppers, since these insects multiply so fast and are so very destructive to vegetation that but for the check on their increase by birds the cost to the farmer of fighting them would be much greater than it is.

Important as is the work of some of the hawks in destroying noxious insects, this is by no means the chief service the group renders man. Within our boundaries are some 50 species of hawks and 35 species of owls. With the exception of perhaps half a dozen hawks, which subsist mainly upon birds, and the great horned owl, hawks and owls are to be classed as beneficial. It is not to be denied that occasionally the larger species carry off a chicken and kill some game, but such acts are exceptions to the general rule. Mice and other small rodents constitute the chief food of such of the species as are not largely insectivorous, and it is by the destruction of these pests of the farmer that hawks and owls earn protection.

Of late years the acreage under cultivation in the United States has increased rapidly and the value of the crops raised has augmented by leaps and bounds. With increased acreage under cultivation the number of rodents has multiplied correspondingly, because of the abundance of nutritious food and also because their natural foes have been destroyed by man. The services of hawks and owls were never so much needed as now, and these faithful helpers of man are likely to be needed still more in the future; yet thousands of hawks and owls are yearly slaughtered because the part they play in nature's scheme is misunderstood or ignored. Unquestionably individual hawks that have learned the way to the poultry yard should be summarily dealt with, but because occasional individuals of two or three species destroy chickens it is manifestly unfair to take vengeance on the whole tribe. The very name "hen hawk" is a misnomer so far as the birds to which it is chiefly applied are concerned. Moreover, it is made the excuse by the farmer's boy and the sportsman for killing every hawk, large and small, that flies. Thousands of these useful birds are killed annually by the thoughtless for no better reason than that, when sitting motionless, they offer an easy target for the small-bore rifle, or, flying, present a tempting mark for the shotgun. So far has popular misapprehension in regard to these birds gone that again and again States and counties have offered bounties for their heads, thus depleting treasuries, and inviting heavy losses to the farmer through the increased numbers of insects and rodents, which it is the function of these birds to hold in check.

WOODPECKERS.—The woodpeckers apparently were expressly designed for the protection of trees, both forest trees and fruit trees. Their chisel-like beaks driven by strong muscles make effective tools with which to dig out of wood the larvæ of burrowing insects, in which work the long extensible tongues greatly aid. The nature and full extent of the services of woodpeckers in the cause of forest growth and preservation are more clearly recognized as the subject is more carefully studied.

Of all our woodpeckers the sapsucker is the one exception to the rule. This species eats many insects, but its fondness for the sap of trees, including apple and other orchard trees, with its habit of cutting out sections of the bark to obtain its favorite tippie, renders it a nuisance in some localities. It is one of a number of birds that are harmful and beneficial by turns or according to locality. Little blame attaches to the orchardist who blacklists the sapsucker; but he should familiarize himself with the appearance of his enemy, that he may distinguish him from other kinds, so that his extreme measure of retaliation may not fall upon innocent species which can ill be spared.

WOOD WARBLERS.—America is peculiarly fortunate in possessing this beautiful group, in some respects unlike the birds of any other land, and excelled by none in grace of form, sprightly motions, and beauty of plumage. The family is large and numbers of the species included in it visit every part of our domain at some season or other. While some live on or near the ground and share with the thrushes the task of hunting for ground-frequenting insects, the great majority haunt the trees and shrubbery, and spend their time gleaning an insect harvest from foliage and twigs. Eggs, larvæ, and adult insects alike are welcome, and when flying insects are dislodged from their hiding places the warblers successfully essay the rôle of flycatchers and snap them up on the wing. No insects are too minute to escape their prying eyes, and they are particularly successful in discovering and devouring plant lice, immense numbers of which infest our fruit and shade trees. Finally, it may be said of the warblers that they are truly insectivorous, as they eat very little vegetable food, and the little they do eat has no special economic value. (See Pl. VI.)

THRUSHES.—The thrushes and their near allies, the bluebirds, are two groups of insectivorous birds, all the members of which are fond of fruit. All sorts of wild berries are highly esteemed by them, and no one will deny that they are quite within their rights in appropriating them. Unfortunately, however, the most prominent member of the group—and in some respects the most highly esteemed—has developed an uncontrollable appetite for cherries, strawberries, and other cultivated fruits which often renders him a nuisance to the grower of small fruits. The fruit grower can hardly be expected to accept the confiding habits and the sweet song of the robin as full payment for a crop of cherries upon which depends a considerable part of his own livelihood and that of his family. In connection with the depredations of the robin, it is confidently believed that mulberry, wild cherry, and other fruit-bearing trees of little or no commercial value can be planted near orchards so as to protect the



A USEFUL INSECT-EATER—KENTUCKY WARBLER.



ONE OF OUR FOREST CONSERVATORS—RED-BELLIED NUTHATCH.

valuable cherry crop and so save the robin from the orchardist's just resentment. If so, all will be well with the robin; for in respect to his general food habits he is exemplary enough, and destroys many noxious insects, including cutworms and caterpillars. The food habits of the robin have been more carefully studied, perhaps, than those of any other of our birds, and special attention has been paid to the subject by the Biological Survey. That the robin's services as a whole far outweigh the injury he incontestably does to small fruits is the opinion of all investigators, and by the farmer at large he can ill be spared.

The catbird, to some extent, shares the ill name earned by the robin, and for the same reasons; but he is comparatively harmless, being neither so abundant near orchards nor so bold a marauder. Nevertheless, the strawberry patch too often knows him to the sorrow of its owner. He also consumes many insects—cutworms, caterpillars, and grasshoppers among the number.

The smaller members of the thrush family, the wood thrush, hermit thrush, and others, are highly insectivorous, and are to be credited with nothing but good. Moreover their melody raises them to the highest rank among American songsters.

TITMICE.—The titmice, like the warblers, are tree frequenters, and the insects they pursue are of the same general character as those eaten by their more nervous and sprightly cousins. Instead of hurrying from tree to tree, and from one branch to another like the warblers, the titmice conduct a comparatively slow and painstaking search and go over their sylvan hunting grounds much more carefully. Another and a far more important fact to their credit is that, like the nuthatches (Pl. VII), they are practically non-migratory, and instead of scurrying off to the sunny Tropics on the first hint of cold weather, as do most of the warblers, they usually winter where they summer. Thus the farmer enjoys the benefit of their services the year round, and hence has twice the incentive to protect them that he has in the case of the migratory species.

SWALLOWS.—The swallows are among the most insectivorous of birds, and it is difficult to overestimate the extent of their services to agriculture. They are flycatchers preeminently, and Nature has been at the utmost pains to qualify them for the delicate task she has set for them—the capture of small insects moving with rapid and uncertain flight through the air. Endowed with the power of swift and enduring flight, swallows cleave the air without apparent effort, turning this way and that, now falling, now rising, following the movements of their prey. The list of species is not lengthy, six only in the States east of the Mississippi and but one more west of that river, but not one of the number could be spared without loss to

the farmer. Valuable at all times and at all places favored by their presence, swallows have a peculiar value to the southern cotton planter, for they prey upon the cotton boll weevil as it flies over the fields on its errand of destruction. The more that swallows can be induced to nest in the cotton States, and the more they can be increased in the North, so as to add to the number that migrate through the South, the better will it be for the cotton planter, and incidentally for the whole country. Especially important is it that swallows be protected from the assaults of the English sparrow, which covets their nesting sites. Not only do these pests drive away swallows from their nests, but they even throw out their eggs and kill the helpless young.

VEGETARIAN BIRDS AND THEIR FOOD HABITS.

It is not possible strictly to divide small birds by their diet into vegetarian and insectivorous kinds, for while many birds live largely upon vegetable substances—some almost exclusively—there are very few that do not, at least occasionally, eat insects (all of them feed their young upon insects); and, it may be added, there are not many insect-eating birds that do not, at least occasionally, vary their diet by berries or other vegetable substances. Pigeons perhaps are more exclusively vegetarian than other birds, the common turtle dove, for instance, apparently never eating insects except when they happen to be contained in seeds or other vegetable food in the form of eggs or larvæ. For present purposes, however, those birds may be considered vegetarian which live chiefly and most of the year upon vegetable food.

It is among this group naturally that we look for enemies of the farmer, for cultivated grains and fruits are often so much more accessible than the wild varieties that it would be strange indeed if birds had not discovered their good qualities and promptly availed themselves of their opportunities.

CROWS.—Crows are as widely as they are unfavorably known for their depredations on corn, especially when it is just sprouting, and their record is further blackened by their appetite for the eggs and nestlings of all small birds and of game birds. Bad as crows are, they yet have redeeming traits, for they devour great numbers of insects, especially grasshoppers and cutworms, and they kill also many meadow mice and other small rodents. The economic status of the crow is, of all birds, one of the most difficult to determine, but the balance is undoubtedly in the bird's favor. The offering of bounties to insure the destruction of crows is mistaken policy, for, as stated above, the crow performs important services to agriculture, and his extermination would be a loss to the country.

BLACKBIRDS.—Blackbirds also, of which there are several species, at times and in certain districts destroy grain. On the other hand, blackbirds consume insects in a wholesale way, and so incline the balance strongly in their favor.

ORIOLES.—Orioles eat insects to a much greater extent than vegetable food and are noted for their fondness for caterpillars. That the good done by orioles far outweighs the harm can not be doubted, especially since it has been ascertained that in the cotton fields orioles are persistent and successful enemies of the cotton boll weevil, and eagerly search the bolls for them, thus invading the very heart of the enemy's citadel.

BOBOLINK.—The bobolink, though in summer a deserved favorite at the North and there chiefly insectivorous, in autumn is responsible for damages to the southern rice patches that annually aggregate many thousands of dollars. The bobolink is thus almost in a class by itself, earning deserved protection in summer at the North by reason of its beautiful song and its insect-eating habits, while incurring the severest penalties at the South in the fall for serious depredations on the rice crop. No fair-minded critic can condemn the southern planter who protects his own by means of powder and shot. The extermination of the bobolink is not possible nor is it desirable, at least from the standpoint of those who cherish the bird in its northern home, but a material reduction of its numbers would probably effect a cure and satisfy the rice planters by making the bird practically harmless.

BLUE JAY.—The blue jay is another of our pronounced vegetarians whose fare, taking the whole year round, is largely composed of insects; and were judgment to be pronounced merely as between the good it does by destroying insects and the harm it inflicts by eating corn and fruit, the verdict would be in favor of the bird. A fact, however, recently brought to light seems to indicate that the blue jay is essaying a new rôle. As is well known, the brown-tail moth was introduced into this country a few years ago, and in the New England States has already inflicted serious injury. It will be fortunate for the country at large if the ravages of the insect can be limited to the States already infested. Contrary to the habits of our native moths the eggs of this foreign intruder hatch in the fall, and the young safely winter in their nests in the trees, to issue in the spring and begin their devastations on the opening foliage. Recently it has been learned that hundreds and thousands of these nests are torn open in winter and the young eaten, and the blue jay has actually been seen doing this. The blue jay will earn the title of benefactor indeed should he be able to contribute materially toward a reduction of this pest, which not only threatens destruction alike to village shade trees and country forest, but seriously afflicts humanity.

by poisoning the flesh with its barbed hairs, which are scattered broadcast by the wind.

GROUSE AND QUAIL.—Grouse and quail are largely vegetarian, though the several species have enviable records as successful hunters of insects. The habit of eating the buds of fruit trees in spring is sometimes cited against our ruffed grouse as a serious fault, but usually trees are not harmed by the process.

The value of all the members of the grouse family, as of waterfowl and waders, for food is great and is constantly increasing as the birds diminish in numbers. Quail have always been favorite objects of pursuit by sportsmen, and by preserving the quail on a large farm, or on a number of adjoining farms, and asking a fair fee from sportsmen for the privilege of shooting, a considerable revenue may be derived, and it is not unlikely that the game on a large tract of, say, several hundred acres may be made to yield a revenue as large as that from a good-sized poultry yard, or even larger. However, perhaps the most valuable service to the farmer rendered by bobwhite is the destruction of the seeds of weeds, although the total number of insects eaten in a year by a covey on the farm is enormous, and it is questionable if the value of game birds to the farmer, especially the quail, as weed and insect destroyers be not greater than their value as a source of revenue from sportsmen or as food. It is pretty safe to assert that, except where grouse and quail are so numerous that a certain percentge of the increase can be spared, the farmer can not afford to sacrifice them to sport or to the market. (See Pl. VIII.)

SPARROW FAMILY.—The finch, or sparrow, family is very important to the agriculturist. The group is large, and in North America comprises more than a seventh of all the birds. Most of them are small and plainly colored; some are gregarious, and most are migratory, leaving the United States in winter. Their chief value to the farmer lies in the fact that the majority of them are indefatigable in their search for seeds of weeds, which indeed constitute a large part of their fare the year round. (See Pl. IX.) Practically all of the food of at least one of them—the tree sparrow—consists of seed. If we estimate that a single tree sparrow eats a quarter of an ounce of weed seed daily—and stomach examinations by Professor Beal show that this is a fair estimate—this species in a State the size of Iowa consumes more than 800 tons of seed annually. And there are many other sparrows whose appetite for weed seed falls little short of that of the tree sparrow.

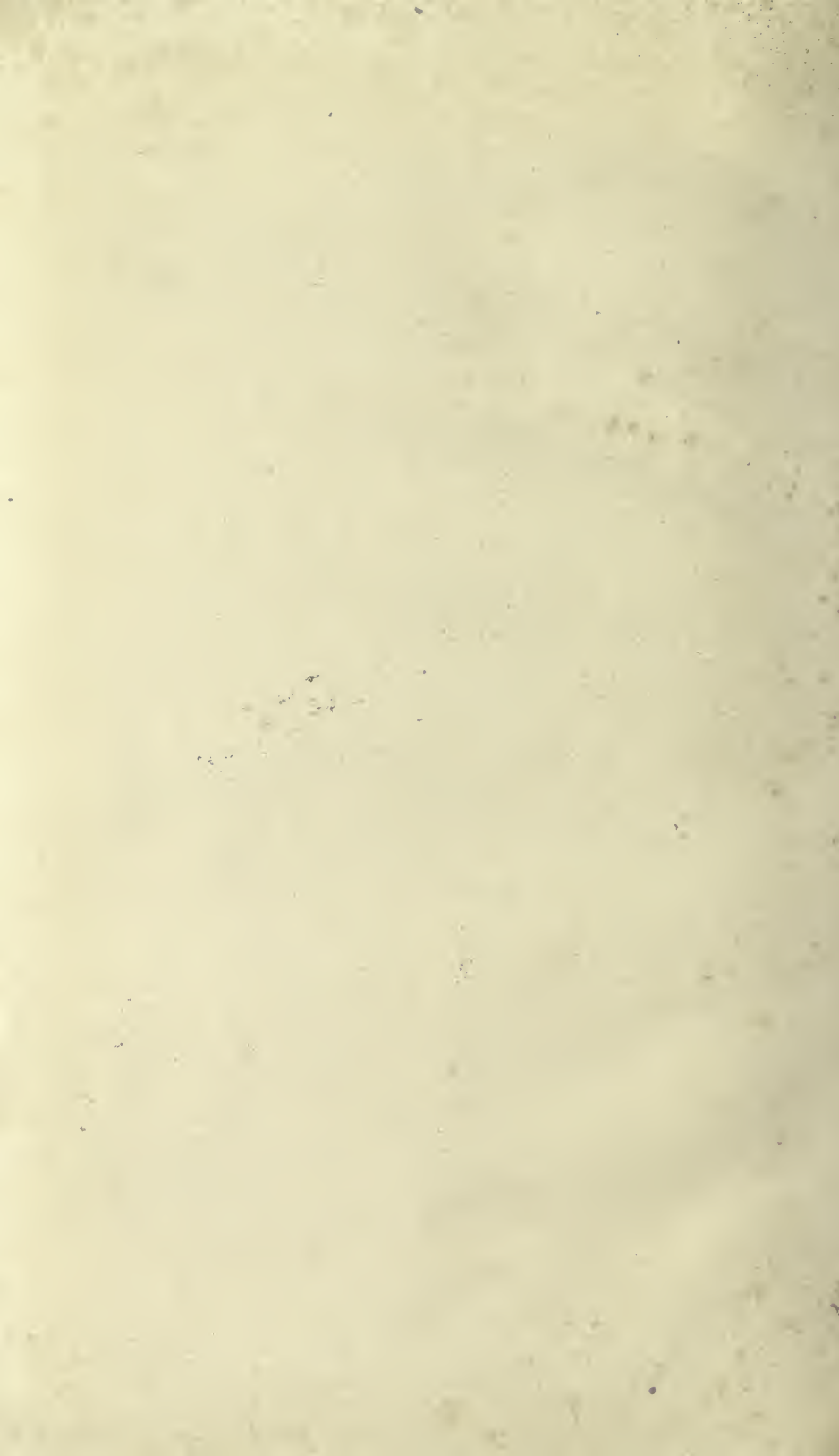
As every farmer knows, the cost of farming is largely augmented by the expense of fighting weeds, the seeds of many of which, especially of certain noxious kinds, are very numerous and are capable of germinating after being long buried in the soil. As weeds have been estimated annually to damage crop land on the average about a



A VALUABLE BIRD IN DANGER OF EXTINCTION—FIELD PLOVER.



A TYPICAL SEED-EATER—WHITE-THROATED SPARROW.



dollar per acre, and as the lands under crop in the United States in 1899 were 290,000,000 acres, the good work accomplished by the sparrows is of very great value to the farmer. Without their aid the cost of fighting weeds would be vastly increased, and no doubt in places profitable agriculture would be almost impossible.

Some of the sparrow tribe, as the purple finch and grosbeak, are fond of buds, and in spring may be frequently seen in apple, cherry, peach, and other trees, greedily eating the buds or the stamens of the blossoms. No doubt a certain percentage of fruit is lost through the agency of these birds, but budding by birds in itself, if not carried too far, is by no means objectionable; and neither of the birds mentioned, nor any native bird that shares the habit, is numerous enough (except in California) or sufficiently confirmed in the habit to seriously reduce the fruit crop. Indeed budding by hand to prevent overbearing and to improve the size and quality of fruit is a common practice, and it is probable that, as stated above, in most cases no actual loss of profit follows budding by our native birds. Whether so or not, the purple finch destroys many insects, caterpillars among them, and hence earns favor in the eyes of the farmer; while a still stronger case may be made out for the rose-breasted grosbeak, which is a most determined foe of the Colorado beetle, and probably destroys more of these dreaded insects than does any other bird—possibly than do all other birds combined. The insects eaten by the old birds, however, are but a tithe of the number they feed to their young, for nestlings thrive best and grow faster on a diet composed almost exclusively of insects.

Until the English sparrow was introduced it would have been safe to say that all the sparrows were friends of the farmer and deserved protection at his hands. Unlike our native species, however, this bird has bad habits far outweighing any possible good that it does, even if the most liberal estimate be made of the comparatively small number of insects that it destroys or the weed seed it eats. It is a conspicuous member of the seed-eating group, as its structure abundantly proves, and this well-known fact should have prevented its introduction into the United States to perform the service of an insect eater. By preference the bird is a scavenger of the city streets. Outside the city the bird's fondness for seeds does not stop with weed seed. The smaller grains are liable to attack at all stages of growth, from sowing time to harvest, and the total damage to the grain crop of the country inflicted by this pest at the present time amounts to many thousands of dollars annually.

This sparrow, like some of our native species, is fond of the buds of fruit trees. Where it exists in small numbers the injury it does in this way, like that of our own sparrows, is too small to count much against it; but the bird is very prolific and in many suburban

towns its colonies are so large that the resulting damage it inflicts upon fruit trees in spring is very great. It is fond also of all the small fruits, and in some regions the damage to fruit as the result of its attacks is considerable.

There is yet another field for the exercise of this pest's pernicious activity. Its aggressive and meddlesome disposition and its habit of acting in concert enables it to overpower and drive away many of our native birds, which before its advent were as numerous about dwellings as they were welcome.

The house wren, the bluebird, the phoebe, and certain swallows are the chief sufferers from the aggressive warfare waged by the sparrow. Even that excellent fighter, the purple martin, is unable to long resist the persistent attacks of a united colony of sparrows, since, when unable to overcome the martin in open warfare, the sparrows enter the nests during the absence of the owners, kill the helpless young, and pitch out the eggs. The result is that not only are the above-named species and other small birds driven away from the localities they used to inhabit, but their numbers have steadily diminished and must continue to do so because of their inability to find other suitable breeding places. Thus the sparrow has usurped the places about our homes by right belonging to our own birds, and its increase has been at the expense of native American species, with the result that a number of highly important useful species have been replaced over large areas by a single destructive one. Not only should all aid and comfort be withheld from this foreign invader, but a concerted effort should be made to reduce its numbers and to exterminate it wherever and whenever possible.

CRANES AND HERONS.—Some of our birds are neither insect eaters nor vegetable eaters. Some of the hawks and owls, as is well known, live chiefly upon flesh, while the cranes, herons, storks, and kingfishers live largely upon fish, crustaceans, and frogs. By eating small fish which are the fry of valuable kinds or serve as their food, these birds do more or less harm, as the fish breeder, whose ponds are invaded, knows well enough. So also their habit of eating frogs is injurious.

But while thus injurious to some extent in certain localities where their pernicious activity may necessitate reprisals, cranes and herons do good service in the destruction of small rodents, especially meadow mice and pocket gophers. As in other cases the relation of these birds to the community varies according to circumstances, and they are to be dealt with accordingly, bearing in mind, so far as possible, the good to the community as a whole and not solely individual interests.

IMPORTANCE OF BIRDS AS DESTROYERS OF INSECTS.

From the foregoing it will be seen that the benefits the farmer derives from birds far outweigh the occasional damage they do. Notwithstanding this, the public, as a rule, is much more alive to the depredations of birds than to the benefits that accrue from them. Nor is this surprising, since the disastrous effects of a raid on sprouting corn by crows, or upon ripening cherries by robins and cedar birds, are too apparent to be overlooked, and the resulting loss can be estimated in dollars and cents. Not so the benefits. Occasionally, it is true, the effects of a combined attack of birds upon caterpillars, cankerworms, or other insects which are present in unusual numbers or have played havoc with the foliage, are too evident wholly to escape attention; but more often birds work unnoticed, and the good they do is not at once obvious to the busy farmer. There are few visible tokens of the process by which the crop of hay or green feed has been saved from the cutworms by crows, or the potato crop rescued from the Colorado beetle by the grosbeaks. The birds have done their work quietly but none the less effectively. They have saved, or greatly assisted in saving, the farmer's crop, and nobody is the wiser, save the few who make it the business of their lives to study the habits of birds.

The time has long passed when the practical farmer can afford to ignore the relation of birds to agriculture. Larger and larger areas are being devoted to tillage every year, and the amount of capital invested in agricultural pursuits in the United States is constantly increasing. Irrigation, until recently almost unpracticed in the United States, is fast assuming national importance. The whole world is being laid under contribution for new fruits, forage plants, and crops for the benefit of the American farmer, in order that by his superior energy and foresight he may not only feed our own people but create a surplus of American products for consumption in less favored lands.

Along with these new introductions and as a necessary result of international commerce, new pests have been introduced. Here, under a favorable climate and new conditions, they multiply till they inflict great damage. The Hessian fly, San Jose scale, and codling moth are examples in point.

Such pests usually go unnoticed until the damage they do forces them on the attention of a community, when usually they are so numerous and widespread that their extermination is impossible. Once introduced into the country they are here to stay, and the vast sums already spent in efforts to stay the ravages of such pests emphasize the importance of utilizing to the utmost all the allies nature places at our disposal.

As a means of checking these introduced insect pests, as well as native ones, birds are of vast importance. Yet it must be remembered that, when once the reproductive powers of insects have had full play and an invasion occurs, the farmer can not suddenly augment the number of birds and summon the winged hosts to his aid. Birds reproduce but slowly, and in the natural course of events often suffer immense losses during their migrations, by climatic extremes and through the assaults of birds of prey and predaceous mammals. Hence a marked increase in the number of birds, either as a class or in the case of a given species, must come slowly and as a result of favoring conditions extending over a term of years. Moreover, as stated above, birds alone are inadequate to cope with sudden insect irruptions. It is their province rather by incessant watchfulness and constant warfare to prevent over-production of insect life rather than to reduce excess, although in the latter regard their aid is important. It is the part of prudence, therefore, to protect useful birds at all times, and so to augment their numbers that they may constantly play their respective parts in the police system ordained by nature and be ready, when emergency arises, to wage active and aggressive warfare against sudden invasions of insect enemies.

PROTECTION OF BIRDS FROM MAN.

Most of our States have laws which, if fully enforced, would go far to secure adequate protection for birds. The wholesale destruction of our songsters and insectivorous birds for millinery purposes has been largely stopped, although even now in some States the statutes are frequently violated by unprincipled bird hunters for the sake of gain. But laws, while wholesome and necessary, are not so effective for the protection of birds as is an enlightened public sentiment. In a country like our own, where education is general, a knowledge of the part birds play in the economy of nature is more effective for their protection than are any laws, however well administered. Instruction of this kind should be given to every school child in the land, and it is gratifying to note that the importance of this practical side of nature study is fast being recognized by educators. When the value of birds is universally known and they are everywhere cherished as friends, protective laws will be comparatively unimportant.

In this connection brief allusion may be made to a class of immigrants to our shores who are ignorant both of our laws and of the need for enforcing them, and who look upon birds, large and small, only as food. Cheap guns and ammunition in the hands of these newcomers furnish means for the indiscriminate slaughter of birds for the pot, and public sentiment is either not recognized or is ignored. Nothing but strict laws, rigidly and impartially enforced, can save our birds from these pot hunters.

MEANS OF ATTRACTING BIRDS TO THE FARM.

There are many ways of attracting birds to the farm and about the farmhouse. A convenient drinking and bathing place near the house is one of the most effective lures for birds known, as well as one of the cheapest. For wrens, swallows, bluebirds, chickadees, and other kinds, which build in cavities of trees, boxes may be put up, care being taken to protect them as far as possible from the aggressive English sparrow. Above all should the farmer pay attention to the cats on his farm. It is only recently that the extent of the depredations of the house cat on wild life, especially on birds, has been recognized. Many who have studied the matter believe that taking the year round cats are responsible for the death of more birds, especially young ones, than all wild animals put together. This may or may not prove to be an exaggeration, but unquestionably cats everywhere, especially on the farm, destroy vast numbers of birds. Even the well-fed and well-housed pet is responsible for many valuable lives, but the greater number are destroyed by strays which mistaken kindness has turned adrift, when not wanted in the house, to live as best they may. An adequate remedy against the bird-catching cat is neither easy to suggest nor to apply, but at least the farmer, who rightfully counts the birds of his farm as his friends, should be expected to destroy the stray cats that infest the country in summer, and, so far as possible, to see to it that the natural instincts of his own house pets are suppressed by ample feeding and reasonable restraint.

MEANS OF PROTECTING CROPS FROM BIRDS.

There are various devices by means of which the farmer may protect his crops from the attacks of birds, reserving the use of the gun as a last resort when all other methods have failed. Scarecrows, a dead crow hung on a pole, a white cord stretched around a field, the drilling of seed, and the tarring of seed corn are some of the old and approved methods of preventing losses by crows and blackbirds. To be effective, no one of these should be employed exclusively or too long at a time in the same locality, since long contact with man has taught the crow a number of things. Fruit trees when few in numbers may be protected by netting. The planting of wild fruit trees, or those possessed of little commercial value, for the protection of orchards has not received the attention in this country that it deserves.

Even when such protective devices fail the farmer is not driven to the wholesale destruction of birds. For it is being more and more recognized that there is much individuality among birds, and that generally the aggressors in a certain locality are a comparatively few

individuals. If the lives of a few destructive hawks, crows, or robins are taken, after other means have been tried and failed, it is often enough to protect the poultry yard or the crop.

FARMERS' GAIN FROM PROTECTING BIRDS.

The brief survey of the subject possible here only imperfectly sets forth the nature and importance of the service of birds to agriculture. Nevertheless it must appear that to the question "Does it pay the farmer to protect birds?" only one answer is possible. Even from the point of view of an investment for profit the time and expense necessary for their care and protection are richly repaid. There is the added consideration that without the music and companionship of birds the world would be the poorer. Anything that adds to the attractiveness of the farm and increases the interest of farm life is worthy of cultivation, even if no actual return is received in dollars and cents. Happily the farmer who protects birds secures a double return—increased profit from his crops and increased pleasure of living.

Issued January 9, 1913.

U. S. DEPARTMENT OF AGRICULTURE
BIOLOGICAL SURVEY—BULLETIN No. 43

HENRY W. HENSHAW, *Chief*

C
INDEX TO PAPERS RELATING TO
THE FOOD OF BIRDS

BY MEMBERS OF THE
BIOLOGICAL SURVEY

IN PUBLICATIONS OF THE UNITED STATES
DEPARTMENT OF AGRICULTURE
1885-1911

BY

W. L. McATEE

Assistant, Biological Survey



WASHINGTON
GOVERNMENT PRINTING OFFICE
1913

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., March 13, 1912.

SIR: I have the honor to transmit herewith, for publication as Bulletin No. 43 of the Biological Survey, an index, by W. L. McAtee, to papers on the food and food habits of birds, published up to December 31, 1911, by the Biological Survey of the Department of Agriculture. Since 1885 no fewer than 131 papers relating wholly or in part to the economic status of birds have appeared in the various publications of the department, including Annual Reports, Bulletins, Faunas, Yearbooks, Farmers' Bulletins, and Circulars. These contain more or less extended accounts of 401 species of native birds and 59 foreign or introduced species. The index serves the two very useful purposes: (1) Of showing just what has and what has not been published by the department on the status of birds in the United States; (2) of greatly facilitating reference to the data contained in the reports.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction.....	7
Annotated bibliography of papers relating to the food of birds.....	8
Bulletins.....	8
Circulars.....	15
Farmers' Bulletins.....	18
North American Faunas.....	19
Annual Reports.....	21
Schedules.....	26
Yearbooks.....	26
Index.....	32

INDEX TO PAPERS RELATING TO THE FOOD OF BIRDS BY MEMBERS OF THE BIOLOGICAL SURVEY IN PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE, 1885-1911.

INTRODUCTION.

The object of this bulletin is to furnish an index to papers by members of the Biological Survey in the various publications of the United States Department of Agriculture up to and including December, 1911, which contain information on the economic status of birds as determined by their food habits. Statements concerning the value of feathers, flesh, eggs, guano, or the use of birds as game are not taken into account, but only notes on bird food or inferences drawn from a consideration of food with definite reference to some species of bird.

The publications indexed are the Bulletins, Circulars, and North American Faunas, published by the Biological Survey, the Annual Reports of its Chief, and the Farmers' Bulletins and Yearbooks, publications of the Department of Agriculture as a whole.

In the 26½ years of its existence, from July 1, 1885, to December 31, 1911, members of the Biological Survey have prepared 131 documents relating wholly or in part to the food of birds. These publications contain notes on the economic status of no fewer than 401 species of native birds and 59 species of foreign or introduced birds. (See table.) In the case of 173 species of native birds and one introduced bird, reports embodying a résumé of printed and communicated testimony concerning the food, together with detailed analyses of stomach contents, have been published. These are the most important statements of the economic value of our birds.

Series of publications.	Number in series.	Number of articles containing economic information.	Number of species of birds receiving economic consideration.			
			Formal reports.		Other notes.	
			Native birds.	Foreign and introduced birds.	Native birds.	Foreign and introduced birds.
Bulletins.....	40	28	162	1	314	28
Circulars.....	84	13			157	2
Farmers' bulletins (by members of Biological Survey).....	23	8			67	4
Faunas.....	34	13			118	11
Annual reports.....	25	37	32		93	15
Yearbooks.....	17	32	9		221	21
Totals (duplicates deducted).....		131	173	1	401	59

ANNOTATED BIBLIOGRAPHY OF PAPERS RELATING TO THE FOOD OF BIRDS.

The first part of this bulletin consists of a bibliography of the publications of the Department of Agriculture that were written by members of the Biological Survey and contain information concerning the food of birds, with brief reviews of the papers. The bibliography is divided into sections, arranged in the following order: Bulletins, Circulars, Farmers' Bulletins, Faunas, Annual Reports, and Yearbooks.

BULLETINS.

BULLETIN 1. The English sparrow (*Passer domesticus*) in North America, especially in its relations to agriculture. By Walter B. Barrows. 405 pp. 1 pl. (frontispiece). 9 figs. 1 colored map [by F. E. L. Beal]. 1889.

This comprehensive publication includes discussion of the introduction of the sparrow, method of diffusion, rate of spread and increase, natural enemies; checks by climate, limits of food supply, and by man; its economic status in Great Britain; injuries to fruits, vegetables, garden seeds, and grain; its relations to other birds and to insects; and an account of miscellaneous injuries. Tables showing the results of analysis of contents of 636 stomachs fill 10 pages. Recommendations for legislation and for private efforts to reduce the numbers of sparrows, a general consideration of bounty laws, and a review of the existing legislation affecting the species are given. The bulletin includes also the following special reports:

Insectivorous habits of the English sparrow, by C. V. Riley, pp. 111-133.

Destruction of the sparrow by poison, by Dr. A. K. Fisher, pp. 174-178.

The trapping of sparrows for sporting purposes, by W. T. Hill, pp. 178-191.

History of the house sparrow (*Passer domesticus*) and the European tree sparrow (*Passer montanus*) at Saint Louis, Mo., by Otto Widmann, pp. 191-194.

Pages 197-357 present in detail the evidence from correspondence and published sources upon which the foregoing parts of the bulletin are largely based. The quotations refer to experience with the English sparrow in Europe, America, Australia, and New Zealand, and include casual references to the economic value of a number of foreign and native birds. A list of all persons whose testimony appears in the bulletin and an unusually complete index are given.

BULLETIN 2. Report on bird migration in the Mississippi Valley in the years 1884 and 1885. By W. W. Cooke. Edited and revised by Dr. C. Hart Merriam. 313 pp. 1 colored map. 1888.

Includes casual references to the character of the food of 11 species, mostly birds of prey.

BULLETIN 3. The hawks and owls of the United States in their relation to agriculture. By A. K. Fisher, M. D. 210 pp. 26 colored pls. 1893.

The introduction (pp. 9-18) to this bulletin summarizes the food habits of the various species and groups them according to their economic value. Then

follows the detailed consideration of the food habits of the species, giving information gleaned from correspondence, published sources, and stomach examination. The results of examinations of 37 species are tabulated. The name "short-winged hawk," given on page 11, is a slip of the pen and should be omitted. The same error occurs in Circular 61, p. 3, 1907; Yearbook 1894, p. 217; 1895, p. 590; 1896, p. 628.

BULLETIN 4. The prairie ground squirrels or spermophiles of the Mississippi Valley. By Vernon Bailey. 69 pp. 3 colored pls. 4 colored maps. 1893.

The natural enemies of spermophiles, including nine hawks and six owls, are discussed in pages 15-18.

BULLETIN 5. The pocket gophers of the United States. By Vernon Bailey. 47 pp. 6 figs. 1 colored map. 1895.

In the treatment of natural enemies, pp. 20-22, two species of hawks and three of owls are mentioned.

BULLETIN 6. The common crow of the United States. 98 pp. 1 pl. 2 figs. 1895.

General habits of the crow. Animal food of the crow. Insect food of the crow. By W. B. Barrows [pp. 9-57 and 68-71, figs. 1-2]. Report on the insect food of the crow. By E. A. Schwarz [pp. 57-67]. Vegetable food of the crow. Protection of crops. By W. B. Barrows [pp. 72-94].

Bulletin 6 treats first of the general habits of the crow, including its migrations and the formation of roosts. Next the animal food is discussed, the principal topics being the relations of the crow to rabbits, mice, ground squirrels, gophers, bats, moles, shrews, sheep, swine, eggs and young of poultry and wild birds, and to tortoises, snakes, lizards, frogs, toads, salamanders, fish, crustacea, and mollusks. The insect food is dealt with in a separate chapter, of which the report by E. A. Schwarz occupies 11 pages. In the chapter on vegetable food this omnivorous bird's corn-pulling habits receive full consideration, as do also its relations to other grains and cultivated fruits. The natural foods most fully treated are mast, weed seeds, wild rice, and wild fruits, particularly sumacs. The bulletin contains casual references to the food of a few other species of birds, and closes with a statement of methods for protecting crops from crows and a discussion of bounty laws and their effects.

BULLETIN 7. [The food and tongues of woodpeckers.] 44 pp. 5 pls. 1895. Preliminary report on the food of woodpeckers. By F. E. L. Beal [pp. 7-33, 1 pl. (frontispiece), figs. 1-4]. The tongues of woodpeckers. Relation of the form of the tongue to the character of the food. By Frederic A. Lucas [pp. 35-44, pls. 1-3].

Formal reports on the food habits of 7 species of woodpeckers and brief notes upon 3 others are given by Professor Beal. The introduction is devoted to a general statement of the food and comparison of the various species. Following this are tables showing the percentage of various elements of the food and the relative proportions of adult and larval Coleoptera found in the stom-

achs of 7 species of woodpeckers. Next the species are taken up separately and the animal and vegetable food and the damage attributed to the birds are fully discussed.

The report on tongues by Doctor Lucas notes the peculiarities of this organ in the different genera, discusses the value of these characteristics in classification, and draws conclusions concerning the relation of the form of the tongue to the character of the food. Plates I-III thoroughly illustrate this interesting anatomical essay.

BULLETIN 8. The jack rabbits of the United States. By T. S. Palmer, M. D. 84 pp. 7 pls. 2 figs. 1896.

2nd ed. with numerous alterations and additions, including appendix of 5 pages. 88 pp. 7 pls. 3 figs. 1897.

The information relating to birds is the same in both editions and occurs on the same page, 44. Eight birds of prey are listed among the natural enemies of jack rabbits.

BULLETIN 9. Cuckoos and shrikes in their relation to agriculture. 26 pp. 1 pl. 1 fig. 1898.

The food of cuckoos. By F. E. L. Beal, B. S. [pp. 7-14, fig. 1].

The food of shrikes. By Sylvester D. Judd, Ph. D. [pp. 15-26, 1 pl. (frontispiece)].

After noting briefly the general habits of the yellow-billed and black-billed cuckoos this bulletin treats their food habits collectively. The almost exclusively insect diet is discussed in detail, and a list is given of the species of insects identified in the stomachs. The food habits of the two species of shrikes are treated separately, and lists of the species identified among the prey are given. The report ends with a tabulation of the percentages of principal food elements by seasons.

BULLETIN 12. Legislation for the protection of birds other than game birds. By T. S. Palmer. 94 pp. 2 pls. (maps). 8 figs. (1 map). 1900.

Revised edition. 143 pp. 4 pls. (maps). 7 figs. (1 map). 1902.

The remarks on bird food in this bulletin relate principally to species which, while often used as game, are outside of the ordinary classes of game birds. It is shown that several of these have very beneficial food habits, and their protection is urged. Brief statements of the character of the food of many other species are given in connection with synopses of legislation occasioned by their beneficial or injurious habits. Lists of the species protected and of those specifically exempted from protection in each State and in the Canadian provinces are presented, also the full text of Federal, State, and Canadian laws for the protection of birds.

BULLETIN 13. Food of the bobolink, blackbirds, and grackles. By F. E. L. Beal, B. S. 77 pp. 1 pl. (map). 6 figs. 1900.

This bulletin contains formal reports on the food habits of the bobolink, the cowbird, and 7 species of blackbirds. The introduction notes the salient features of the food of the various species and compares them one with another. The individual treatment of the species comprises discussion of their relations to crops, particularly grain (rice in the case of the bobolink), and a complete

synopsis of the remaining vegetable food and of the insect and other animal food. Tabulations of the principal food items, by months, follow the general account of each species, and diagrams graphically conveying the same information are given for the bobolink, cowbird, and red-winged blackbird.

BULLETIN 15. The relation of sparrows to agriculture. By Sylvester D. Judd, Ph. D. 98 pp. 4 pls. 19 figs. 1901.

The introductory matter in Bulletin 15 comprises a statement of the importance of sparrows, a general account of the principal constituents of their food, and a description of the methods of ascertaining the economic value of birds, including observations in the field and examination of stomachs in the laboratory. Under the food of sparrows as a group are discussed mineral substances found in sparrows' stomachs, food neutral in effect on agriculture, food injurious in effect, and food beneficial in effect. The behavior of sparrows and their habits of feeding in the natural state are described at length, and results of experiments with captive birds are compared with those of the investigation of stomach contents. The caged sparrows were also used to test the efficacy of the various so-called "protective" adaptations of insects, and the resistance of certain hard-coated seeds to the digestive action of the birds. The remainder of the bulletin is devoted to a discussion of the food of sparrows by species. Details of the animal and vegetable food of 26 species are given. Plate IV shows the percentages of the principal food items of 6 species by the graphic method of proportionate sectors of circles. The bulletin contains casual references to the food of numerous species of birds not formally treated.

BULLETIN 17. Birds of a Maryland farm. A local study of economic ornithology. By Sylvester D. Judd, Ph. D. 116 pp. 17 pls. (1 map). 41 figs. 1902.

"Birds of a Maryland Farm" is an account of the relations of all the birds occurring on a 230-acre farm near Marshall Hall to all of the animals and plants used by them for food. Several pages are devoted to a discussion of the local distribution of birds as influenced by topography, nesting facilities, and food supply. In Chapter II is described the behavior of birds during periods of unusual abundance of certain insects, as well as their relations to useful insects and to the standing pests of the various cultivated crops, trees, shrubs, and herbage. The food of the nestlings of several species is described in detail. Chapter III deals with the birds that prey upon poultry, wild birds, fish, carrion, mice, and rabbits, and Chapter IV with those that eat wild and cultivated fruit; this chapter contains also notes on the distribution of seeds by birds. The principal grain eaters are treated in Chapter V and the consumers of weed seed in Chapter VI. The remainder of the bulletin is devoted to a discussion of the food by species or by larger groups. Bulletin 17 represents the results of the most complete study of local economic ornithology that has been made. It gives notes on the food of no fewer than 133 species of birds.

BULLETIN 21. The bobwhite and other quails of the United States in their economic relations. By Sylvester D. Judd. 66 pp. 2 pls. (1 colored). 10 figs. 1905.

Two-thirds of this publication is devoted to a single species, the bobwhite. The discussion of the general habits of the bird, its value as food, as an object of sport, and as an asset on the farm, is very full. The decrease in numbers of the bird, legislation in its behalf, and measures for preservation and propa-

gation, are considered at length. The food is dealt with under the following topics: Grain, weed seeds, mast and pine seeds, fruits, leaves and buds, beetles, bugs, grasshoppers and allied insects, caterpillars, miscellaneous animal food, and food of the young. One hundred and twenty-four different insects and other animals were identified in the stomachs and 138 seeds and fruits. Information of the same character, briefer in all cases, the volume depending on the number of stomachs available for examination, is given for six other species of quails.

BULLETIN 22. Birds known to eat the boll weevil. By Vernon Bailey. 16 pp. 1905.

This bulletin is a preliminary report on the investigations of boll-weevil-eating birds. Notes are given on 11 species of birds in whose stomachs E. A. Schwarz of the Bureau of Entomology found boll weevils and on 9 species added to this list by investigations by the Biological Survey. The field work was done by James G. Gaut and Vernon Bailey; the stomachs were examined by F. E. L. Beal.

BULLETIN 23. The horned larks and their relation to agriculture. By W. L. McAtee. 37 pp. 2 pls. 13 figs. 1905.

The horned larks of the United States belong to a single species composed of 21 subspecies. Their food habits are treated collectively in this bulletin, except for a Californian subspecies (*Otocoris alpestris actia*), which owing to environment is considerably more vegetarian than the other members of the group. The general habits and economic relations are first discussed, then the vegetable food is considered under the following heads: Wheat, corn, oats, other grains and forage plants, weeds, fruit, and miscellaneous vegetable food. The animal food, mineral matter, and food of the nestlings and other young horned larks precede the account of the California subspecies. This is followed by the summary and a list of seeds, fruits, and invertebrates eaten by the horned larks, which includes 77 items of animal food and 104 of vegetable.

BULLETIN 24. The grouse and wild turkeys of the United States and their economic value. By Sylvester D. Judd. 55 pp. 2 pls. (1 colored). 1905.

The food habits of 12 species of grouse and the wild turkey are described in this bulletin, the fullest accounts dealing with the prairie hen and the ruffed grouse. The insect food, which generally includes a goodly proportion of grasshoppers, and the vegetable food, characterized by the preponderance of berries, buds, and leaves, or browse, are discussed in detail. In the case of the ruffed grouse no fewer than 45 items of animal food and 120 of vegetable are listed.

BULLETIN 25. Birds that eat the cotton-boll weevil. A report of progress. By Arthur H. Howell. 22 pp. 1906.

This "report of progress" on the boll-weevil investigation adds 8 species to the list in Bulletin 22, making 28 in all known to feed on the weevil. The most important notes are those on the orioles, nighthawk, and flycatchers. On pages 19-20 is a brief discussion of the relations of birds to cotton worms. Tables giving the records of birds examined which had and which had not eaten boll weevils conclude the paper. The field work done since the publication of the first report (Bulletin 22) was by A. H. Howell; the stomachs were examined by F. E. L. Beal and W. L. McAtee.

BULLETIN 27. The North American eagles and their economic relations. By Harry C. Oberholser. 31 pp. 2 pls. 2 figs. (maps). 1906.

This report is a compilation of information on the habits and distribution of 3 species of eagles—the bald, the golden, and the gray sea eagles. Their relations to fish, wild birds, poultry, and wild and domestic mammals are discussed and opinions given as to their economic status. Maps showing the breeding ranges of the bald eagle and the golden eagle are included in the bulletin.

BULLETIN 29. The relation of birds to the cotton-boll weevil. By Arthur H. Howell. 31 pp. 1 colored pl. 6 figs. Oct. 10, 1907.

Bulletin 29 is a résumé of the study of birds in relation to the boll weevil. Forty-three species are listed (on page 6) as enemies of the insect, adding 15 to the list in Bulletin 25. Recommendations of measures designed to increase the efficiency of bird enemies of the pest include proposals for legislation in favor of the upland and killdeer plovers and the blackbirds, and suggestions for the special protection of swallows, meadow larks, and painted buntings. Nesting boxes for purple martins are described and illustrated. The relations of the various groups of birds to the boll weevil are described separately, the results of the field work of 1906 and 1907 are given, and the paper ends with tabulated records of birds examined which had and which had not eaten boll weevils. The field work was carried on by the author and the stomachs were examined by W. L. McAtee.

BULLETIN 30. Birds of California in relation to the fruit industry. Part I. By F. E. L. Beal. 100 pp. 5 pls. (1 colored). Nov. 11, 1907.

The introductory paragraphs in this bulletin state the general problem of the relations of birds to cultivated fruit in California. They serve as an introduction to both Part I, the present bulletin, and Part II, issued as Bulletin 34. The status of birds in newly settled regions, the effect of migration on the economic relations, the causes of depredations, conditions in California compared with those in the Eastern States, and protective measures, such as the planting of decoy plants and provision of water supplies, are some of the subjects discussed in the introduction. It is shown that, while birds are usually destructive to crops in newly planted regions, "experience everywhere shows that after a time there is a partial readjustment of conditions, so that inroads by birds become much less common or wholly cease." The usual causes of damage by birds wherever or whenever occurring are defined; the principal bird enemies of fruit in California are named in order of importance, following which are the separate accounts of the species. The food habits of 35 species are fully discussed, including the most important species from the tanagers to the thrushes, in systematic order, together with the linnet, or house finch, the worst fruit pest among the birds in the State. The account of this species is based upon the examination of 1,206 stomachs. The food of the nestlings or young of several species is described, the most extended account dealing with those of the russet-backed thrush.

BULLETIN 31. An economic study of field mice (genus *Microtus*). By David E. Lantz. 64 pp. 8 pls. 3 figs. Oct. 28, 1907.

In treating the natural enemies of field mice the author mentions some 50 species of birds, including shrikes, cuckoos, crows, herons, bitterns, storks,

ibises, gulls, hawks, and owls. In many cases a brief summary of the general food habits of the species is given, and notes on the diet of the same bird in the Old World or of related European species are also presented.

BULLETIN 32. Food habits of the grosbeaks. By W. L. McAtee. 92 pp. 4 pls. (3 colored). 40 figs. Feb. 29, 1908.

The pine and evening grosbeaks receive only passing mention, but the cardinal, gray, rose-breasted, black-headed, and blue grosbeaks are discussed in detail. The account of each species includes a description of the appearance of the bird, its distribution and habits, the details of its vegetable and animal food, mineral matter found in the stomachs, and the food of the nestlings and other young birds. Lists of the seeds, fruits, and invertebrates eaten by each species are given. One chapter discusses the relations of grosbeaks and other birds to parasitic insects. Some mention is made of the food of about 30 species of birds besides grosbeaks, these references occurring mainly in lists of bird enemies of rose chafers and potato beetles and in an account of birds that feed on mulberries.

BULLETIN 33. The brown rat in the United States. By David E. Lantz. 54 pp. 3 pls. 4 figs. May 29, 1909.

Four owls and seven hawks are mentioned among the natural enemies of the brown rat. One of the owls is said to attack also the black rat.

BULLETIN 34. Birds of California in relation to the fruit industry. Part II. By F. E. L. Beal. 96 pp. 6 colored pls. Aug. 8, 1910.

This bulletin continues the account of the food habits of California birds begun in Bulletin 30. It states that only four of the species of birds common in California (the linnet, California jay, Steller jay, and red-breasted sapsucker) can be regarded as of doubtful utility. The animal and vegetable food of 32 species is fully treated, especially in relation to fruit culture. As in Part I the food of the young is a special feature. Nestlings of 9 species were studied and reported upon, the fullest accounts dealing with the California towhee and the black-headed grosbeak. Part I discussed one species of the sparrow family, that worst fruit pest, the linnet, and important species of the families Tanagridæ (tanagers) to Turdidæ (thrushes) in the order of the check-list of North American Birds by the American Ornithologists' Union. Part II deals with the principal species in the families Tetraonidæ (grouse and quails) to Fringillidæ (sparrows, finches, and grosbeaks).

BULLETIN 37. Food of the woodpeckers of the United States. By F. E. L. Beal. 64 pp. 6 pls. (5 colored). 3 figs. May 24, 1911.

The accumulation of woodpecker stomachs in the 16 years since the publication of Bulletin 7 enabled Professor Beal to present in Bulletin 37 formal reports on the food habits of 16 species, 9 more than were treated in the preliminary report. Brief notes upon the food of 6 other species also are included; the food of 11 species of woodpeckers which were not even mentioned in Bulletin 7 is discussed. Tables are given showing the comparative rank of the species as consumers of animal and vegetable food and of ants and beetles.

BULLETIN 38. Birds of Arkansas. By Arthur H. Howell. 100 pp. 7 pls. (1 colored map). 4 figs. (maps). Oct. 12, 1911.

A section of the introduction to this bulletin is devoted to a general statement of the economic value of birds, and brief notes on the food of 126 species are scattered through the text.

BULLETIN 39. Woodpeckers in relation to trees and wood products.
By W. L. McAtee. 99 pp. 12 pls. (2 colored). 44 figs. Sept. 26, 1911.

This bulletin deals principally with the relations of three species of woodpeckers—the true sapsuckers—to living trees and the effect of their work upon the value of the articles into which the wood of these trees is manufactured. The sapsuckers are known to attack at least 258 trees, shrubs, and vines, of which 32 are sometimes killed and 63 seriously injured. Defects due to sapsucker work have been found in the wood of 174 species of trees, in 90 of which they are at times so serious as to spoil the appearance or workability of the wood, and in 22 species they sometimes render the wood useless except for coarse construction or for fuel. The damage done to fence posts, telephone poles, and buildings by 10 other species of woodpeckers is also discussed.

CIRCULARS.

The Biological Survey had its origin as a section of Economic Ornithology established under the Division (now Bureau) of Entomology. Four circulars of that division (Nos. 18, 20, 24, and 27) were published in the interest of the new subdivision, and one of them, No. 20, relates to the food habits of birds.

The earliest circulars of the Division of Economic Ornithology and Mammalogy were largely devoted to requests for information and letters of acknowledgment, which are now issued as "forms." Directions for preparing specimens, contained in Nos. 4, 11, and 12, and later Nos. 46 and 49, are still issued as circulars. Aside from these circulars, No. 17, *Bird Day in the Schools*, is the only one up to No. 27, inclusive, which is intended for the diffusion rather than the acquisition of knowledge.

Most of the circulars issued since No. 28 (1900) are short articles conveying information which it was desirable to give speedy publicity. Six of them are devoted to economic ornithology and five others contain brief references to the economic status of certain birds. Two of the latter (Nos. 29 and 38) were issued from the office of the Secretary and hence do not fall into the class of publications here indexed. No. 29, *Protection and Importation of Birds under Act of Congress approved May 25, 1900*, discusses the Lacey Act and refers (pp. 1, 3, 4, and 5) to prohibition of entry of injurious species, including the starling and English sparrow. No. 38, *Interstate Commerce in Birds and Game*, lists (p. 2) robins, swallows, cedar birds, meadowlarks, flickers, and nighthawks as insectivorous, and longspurs, snow buntings, and shore larks as useful in destroying weed seeds.

DIVISION OF ENTOMOLOGY.

CIRCULAR 20. [Circular on economic ornithology.] By Dr. C. Hart Merriam. [2 pp. of print and 2 blank for answers to questions, unnumbered.] July 1, 1885.

This circular briefly states the general problem of economic ornithology and the need of information. Questions relating to the food of 9 species of birds denote by implication the economic relations of these birds. The damage done in the South by the bobolink and red-winged blackbird is mentioned.

BIOLOGICAL SURVEY.

CIRCULAR 1. Circular on the food habits of birds. By Dr. C. Hart Merriam. [3 pp., not numbered.] July 20, 1886.

This circular consists largely of questions relating to the food habits of the crow, the crow blackbird, and the bobolink. Few direct statements are made regarding the food, but much is implied.

CIRCULAR 2. Circular on the English sparrow (*Passer domesticus*). By Dr. C. Hart Merriam. [1 p., unnumbered.] July 20, 1886.

Consists entirely of questions concerning the food of the English sparrow and its relations to other birds.

CIRCULAR 5. Circular to rice growers. By Dr. C. Hart Merriam. [1 p., unnumbered, 1886.]

Notes damage done to rice by the bobolink and red-winged blackbird and contains queries designed to bring out the nature and extent of the injury.

CIRCULAR 17. Bird day in the schools. By T. S. Palmer. 4 pp. July 2, 1896.

The history of bird day is given, the manner of its observance, and the objects and value of the day. Notes are given on the economic status of hawks, owls, and the English sparrow, and the bad results from bounty laws aimed against these birds.

CIRCULAR 34. Laws for the protection of birds and game in the District of Columbia. By T. S. Palmer. 8 pp. Oct. 25, 1901.

This circular quotes the Lacey Act, which contains the names of the starling and the English sparrow in the clause prohibiting the importation of injurious species.

CIRCULAR 56. Value of swallows as insect destroyers. By H. W. Henshaw. 4 pp. Apr. 27, 1907.

This circular shows the great value of swallows as insect destroyers and the importance of protecting them wherever found. It emphasizes the peculiar value of these birds in the war against the cotton-boll weevil, and asks the cooperation of citizens of Northern States, where these birds chiefly nest, in an effort to increase their numbers. The enemies of swallows, especially the English sparrow, are noted, and suggestions for preventing their attacks, as well as for attracting the swallows themselves, are given. The circular includes also directions for colonizing martins and for rearing their young.

CIRCULAR 57. Birds useful in the war against the cotton-boll weevil.

By H. W. Henshaw. 4 pp. Apr. 27, 1907.

This circular directs attention to the importance of birds as enemies of the boll weevil and to the need of protecting them. Orioles, the nighthawk, and swallows are given special consideration and a few other species known to eat boll weevils are mentioned. Measures for protecting and attracting swallows are given. The suggestions for aiding the purple martin are especially full, including remarks on colonization, food for young, the English sparrow as an enemy, and the provision of martin houses.

CIRCULAR 61. Hawks and owls from the standpoint of the farmer.

By A. K. Fisher. 18 pp. 6 figs. July 18, 1907.

This circular condenses the information presented in Bulletin 3 and is a direct revision of the article in the Yearbook for 1894 (pp. 215-232). Brief summaries of the food habits of 33 species of hawks and owls are given, and 14 others are merely mentioned in the list of those classed as chiefly beneficial.

CIRCULAR 64. Destruction of the cotton-boll weevil by birds in winter. By Arthur H. Howell. 5 pp. 1 map. June 19, 1908.

Thirty species of birds were discovered to feed upon the boll weevil in winter. Every death of a weevil at that season "prevents the production of very numerous progeny during the early summer and postpones the date when the increase will become so great as to destroy the cotton squares as fast as they appear." The more important species are the blackbirds, meadow larks, sparrows, titlarks, wrens, and titmice. According to Howell's estimates titlarks alone destroy about 72,000 boll weevils during the winter on each large plantation. The circular ends with a tabulated seasonal record of the birds which had eaten boll weevils. This list of 53 increases by 10 the number of species reported in Bulletin 29.

CIRCULAR 76. The California ground squirrel. By C. Hart Merriam.

15 pp. 4 figs. (1 map). Nov. 25, 1910.

Contains a few references to bird enemies of *Citellus beechyi*, and discusses danger to small birds from poisoned grain laid for the ground squirrels.

CIRCULAR 79. Our vanishing shorebirds. By W. L. McAtee. 9 pp. 3 figs. April 8, 1911.

The value of shorebirds has not been recognized in the past and they have been hunted until only a remnant of their once vast numbers is left. The fact that these birds have a decided economic value is demonstrated in this publication, and their protection is urged. The name ringed plover (*Aegialitis hiaticula*) near the bottom of p. 4 of this circular should be piping plover (*Aegialitis meloda*).

CIRCULAR 80. Progress of game protection in 1910. By T. S. Palmer and Henry Oldys. 36 pp. 1 fig. (map). June 29, 1911.

Classes the starling as injurious.

CIRCULAR 81. Three important wild duck foods. By W. L. McAtee. 19 pp. 19 figs. (3 maps). Sept. 9, 1911.

Written primarily to furnish information on the methods of propagating wild rice, wild celery, and pondweeds, this circular briefly notes the importance of these plants as food for 17 species of wild ducks. A table on the first page shows the percentages of the food of 16 species furnished by these plants.

FARMERS' BULLETINS.

FARMERS' BULLETIN 54. Some common birds in their relation to agriculture. By F. E. L. Beal, B. S. 40 pp. 22 figs. May, 1897.

Revised edition. 48 pp. 22 figs. March, 1904.

The original edition (1897) contains summaries of the food habits of 28 species and brief references to the nature of the food of 8 others. The revised edition (1904) contains 40 specific summaries and notes on 14 species. Farmers' Bulletin 54 is the one article on bird food to have if the complete series of bulletins and other publications of the Biological Survey is inaccessible. Many of the food summaries, though brief, are important, being based on the examination of large numbers of stomachs. Several of them, for instance those on the kingbird, cedar bird, robin, and bluebird, are the most comprehensive statements yet published on the economic relations of these common and important birds.

Farmers' Bulletin 54 has (up to Oct. 15, 1912) been reprinted 39 times, and a total of 595,000 copies has been distributed.

FARMERS' BULLETIN 160. Game laws for 1902. A summary of the provisions relating to seasons, shipment, sale, and licenses. By T. S. Palmer and H. W. Olds. 56 pp. 3 figs. (maps). 1902.

FARMERS' BULLETIN 180. Game laws for 1903. A summary of the provisions relating to seasons, shipment, sale, and licenses. By T. S. Palmer, Henry Oldys, and R. W. Williams, jr. 56 pp. 4 figs. (maps). 1903.

Each of these bulletins quotes the Lacey Act, a clause of which prohibits importation of the English sparrow and starling as injurious birds.

FARMERS' BULLETIN 197. Importation of game birds and eggs for propagation. By T. S. Palmer and Henry Oldys. 27 pp. 1 fig. (map). 1904.

Contains a note on the feeding habits of some capercaillie liberated in Algonquin National Park, Canada.

FARMERS' BULLETIN 335. Harmful and beneficial mammals of the arid interior, with special reference to the Carson and Humboldt Valleys, Nevada. By Vernon Bailey. 31 pp. 9 figs. Oct. 21, 1908.

Among the natural enemies of the Carson meadow mouse (*Microtus montanus*) are listed ravens, magpies, and shrikes. Each of these names can refer to only a single species in the region covered by the bulletin and for this reason is indexed. General references (such as hawks, owls, and birds of prey) are numerous but unfit for indexing.

FARMERS' BULLETIN 352. The Nevada mouse plague of 1907-8. By Stanley E. Piper. 23 pp. 9 figs. Mar. 20, 1909.

This bulletin comments on the destruction of many individuals of 5 species of birds by wheat poisoned with phosphorus, which was put out to kill meadow mice. Several birds are listed among the natural enemies of the mice.

FARMERS' BULLETIN 383. How to destroy English sparrows. By Ned Dearborn. 11 pp. 4 figs. Jan. 20, 1910.

A brief review of the food habits of the English sparrow is given in the introduction.

FARMERS' BULLETIN 390. Pheasant raising in the United States. By Henry Oldys. 40 pp. 17 figs. Apr. 18, 1910.

Crow mentioned among enemies of pheasants.

FARMERS' BULLETIN 456. Our grosbeaks and their value to agriculture. By W. L. McAtee. 14 pp. 3 figs. June 30, 1911.

An abstract of Biological Survey Bulletin 32, containing brief summaries of the food habits of five species of grosbeaks.

FARMERS' BULLETIN 470. Game laws for 1911. A summary of the provisions relating to seasons, shipments, sale, limits, and licenses. By Henry Oldys, C. E. Brewster, and Frank L. Earnshaw. 52 pp. 2 figs. (maps). August 21, 1911.

Starling and English sparrow mentioned as injurious.

NORTH AMERICAN FAUNAS.

This series of publications comprises the more technical papers, such as monographs of certain groups of mammals and descriptions of new species, in addition to accounts of the scientific results of explorations of certain States or other districts. The annotated lists of birds, which are a prominent feature of the latter class of faunas, often contain notes on bird food. These notes are usually definite records of stomach examinations or of observations in the field. They are indexed in detail; hence it is not necessary for users of the index to consult the pages of the faunas themselves, unless they desire to learn the combinations of items in individual stomachs, the quantity of food taken, or details of the feeding habits.

FAUNA 3. Results of a biological survey of the San Francisco Mountain region and desert of the Little Colorado, Arizona. 136 pp. 5 colored maps. 13 pls. 2 figs. Sept. 11, 1890.

Part 4.—Annotated list of birds of the San Francisco Mountain plateau and the desert of the Little Colorado River, Arizona. By Dr. C. Hart Merriam [pp. 1-101, pls. I-XI, colored maps 1-4].

FAUNA 5. Results of a biological reconnoissance of south-central Idaho. 132 pp. 4 pls. (1 colored). 4 figs. July 30, 1891.

Results of a biological reconnoissance of Idaho, south of latitude 45° and east of the thirty-eighth meridian, made during the summer of 1890, with annotated lists of the mammals and birds, and descriptions of new species. By Dr. C. Hart Merriam [pp. 1-108, pls. 1-4, figs. 1-4].

FAUNA 7. The Death Valley expedition. A biological survey of parts of California, Nevada, Arizona, and Utah. 402 pp. 15 pls. 2 figs. 5 colored maps. May 31, 1893.

Report on the ornithology of the Death Valley expedition of 1891, comprising notes on the birds observed in southern California, southern Nevada, and parts of Arizona and Utah. By A. K. Fisher, M. D. [pp. 7-158, colored map 3].

FAUNA 14. Natural history of the Tres Marias Islands, Mexico. 97 pp. 1 pl. [map]. 2 figs. April 29, 1899. Birds of the Tres Marias Islands. By E. W. Nelson [pp. 21-62].

FAUNA 16. Results of a biological survey of Mount Shasta, California, by C. Hart Merriam. 179 pp. 5 pls. 46 figs. October 28, 1899.

FAUNA 19. Results of a biological reconnoissance of the Yukon River region. 100 pp. 7 pls. [1 map]. Oct. 6, 1900. Birds of the Yukon region, with notes on other species. By Louis B. Bishop, M. D. [pp. 47-96].

FAUNA 21. Natural history of the Queen Charlotte Islands, British Columbia. Natural history of the Cook Inlet region, Alaska. By Wilfred H. Osgood. 87 pp. 7 pls. [1 map]. 1 fig. [map]. Sept. 26, 1901.

FAUNA 22. A biological investigation of the Hudson Bay region. By Edward A. Preble. 140 pp. 14 pls. [1 map]. Oct. 31, 1902.

FAUNA 24. A biological reconnoissance of the base of the Alaska Peninsula. By Wilfred H. Osgood. 86 pp. 7 pls. [2 maps]. Nov. 23, 1904.

FAUNA 25. Biological survey of Texas. Life zones, with characteristic species of mammals, birds, reptiles, and plants. Reptiles, with notes on distribution. Mammals, with notes on distribution, habits, and economic importance. By Vernon Bailey. 222 pp. 16 pls. [6 maps]. 24 figs. [16 maps]. Oct. 24, 1905.

FAUNA 27. A biological investigation of the Athabaska-Mackenzie region. By Edward A. Preble. 574 pp. 25 pls. [4 maps]. 16 figs. [4 maps]. October 26, 1908.

FAUNA 30. Biological investigations in Alaska and Yukon Territory. 1. East central Alaska. 2. The Ogilvie Range, Yukon. 3. The Macmillan River, Yukon. By Wilfred H. Osgood. 96 pp. 5 pls. [1 map]. 2 figs. [maps]. October 7, 1909.

FAUNA 33. A biological survey of Colorado. By Merritt Cary. 256 pp. 12 pls. [1 map]. 39 figs. [29 maps.] Aug. 17, 1911.

ANNUAL REPORTS.

Each of the Annual Reports of the Department of Agriculture consists of the report of the Secretary of Agriculture together with those of the chiefs of the various bureaus and divisions. Only the reports of the Chief of the Bureau of Biological Survey and of its predecessor, the Division of Ornithology and Mammalogy, are of interest in the present connection. The first report deals with economic investigations carried on from July 1, 1885, to February 20, 1887, a period of more than one and a half years. All subsequent reports cover approximately a period of one year.

Up to and including the Report for 1893, original articles corresponding to those now published in the Yearbook, and written by various members of the division, accompanied the reports of the chief. Seventeen of them appeared in the eight reports specified. Beginning with that for 1894 the reports of the chief are of a more routine character, containing the customary review of the year's work, plans for the succeeding year, and recommendations. Frequently, however, specific references to bird food are made and all of these are indexed. The comment on each report in the following bibliography gives an idea of the subjects more generally treated.

1886

Report of ornithologist and mammalogist. By C. Hart Merriam. pp. 227-258. 2 figs. 1 colored map.

This first report includes a preliminary discussion of the economic relations of the English sparrow, describes the depredations on rice of bobolinks and red-winged and boat-tailed blackbirds, and refers casually to the food of several other birds.

1887.

Report of the ornithologist and mammalogist. [By C. Hart Merriam.] pp. 399-401.

Notes progress of the investigation of the English sparrow and considers the feasibility of the use of trained hawks in keeping bobolinks out of rice fields.

Food of hawks and owls. By Dr. A. K. Fisher. pp. 402-422.

Consists mainly of a tabulation of contents of 1,072 stomachs, representing 28 species of hawks and owls.

Experiments in poisoning. By Dr. A. K. Fisher. pp. 423-426.

States efficiency in poisoning English sparrows of various preparations of strychnine, arsenic, and corrosive sublimate, in combination with wheat, meal, and hempseed.

Report on some of the results of a trip through parts of Minnesota and Dakota. By Vernon Bailey [birds, pp. 428-431].

Discusses the relations of blackbirds, cowbirds, and bobolinks to the grain crops in this region. Notes on some other articles of diet are given for these birds as well as for a few other species.

Notes on the depredations of blackbirds and gophers in northern Iowa and southern Minnesota in the fall of 1887. By Dr. A. K. Fisher [birds, pp. 454-455].

This report is supplementary to the last, dealing with the habits of the birds in fall and estimating the percentage of destruction, while Mr. Bailey described the depredations that occurred in spring.

1888.

Report of the ornithologist and mammalogist. By C. Hart Merriam. pp. 477-484.

Describes the progress of work on various economic projects and gives an example of one of the labels used on a collection exhibited at the Centennial Exposition of the Ohio Valley and Central States, Cincinnati, July-November, 1888, which contains a brief statement of the food of the red-tailed hawk.

Introduced pheasants. By Dr. C. Hart Merriam. pp. 484-488.

This paper gives an account of the introduction of pheasants and sand grouse into Oregon and Washington. Notes on damage to field and garden crops apparently pertain solely to the ring pheasant (*Phasianus torquatus*).

The sparrow hawk (*Falco sparverius*). By Dr. A. K. Fisher. pp. 491-496. 1 fig.

A review of the testimony of observers as to the economic value of the sparrow hawk, together with a report upon the examination of 163 stomachs.

The short-eared owl (*Asio accipitrinus*). By Dr. A. K. Fisher. pp. 496-498. 1 fig.

Summarizes the recorded observations upon this bird's food and states briefly the results of 50 stomach examinations.

The food of crows. By Walter B. Barrows, S. B. pp. 498-535.

This is a preliminary presentation of the material elaborated later in Bulletin 6 of the Biological Survey. Both the common crow (*Corvus brachyrhynchos*) and the fish crow (*Corvus ossifragus*) are treated, and the results of examination of 86 stomachs of the former and 12 of the latter are given. The economic relations of crows are discussed under the following headings: Injury to corn, wheat, and other cereals; damage to other crops; other vegetable food; the distribution of noxious seeds; the destruction of the eggs and young of poultry and wild birds; insect food; the crow as an enemy of field mice and other small quadrupeds; miscellaneous animal food; and the crow as a scavenger.

The rose-breasted grosbeak (*Habia ludovicana*). An enemy to the Colorado beetle or potato bug. [By W. B. Barrows.] pp. 535-536.

Compiles field observations on this point and emphasizes value of the bird.

1889.

Report of ornithologist and mammalogist. By C. Hart Merriam. pp. 363-370.

Contains references to the food of several species of birds then being investigated by the division.

Marsh hawk. *Circus hudsonius*. By Dr. A. K. Fisher. pp. 370-372. Plate I (colored).

Common screech owl. *Megascops asio*. By Dr. A. K. Fisher. pp. 372-376. Plate II (colored).

Flammulated screech owl. *Megascops flammeolus*. [By Dr. A. K. Fisher.] p. 376.

These three articles are arranged on the same plan, each stating the range of the species treated and its general habits, following this with a compilation of what has been observed regarding its food habits.

1890.

Report of the ornithologist and mammalogist. By C. Hart Merriam. pp. 277-280.

The general nature of the food of crows and the relation of meadowlarks to clover seed are briefly discussed and the economic value of a few other species is mentioned.

Seed planting by birds. By Walter B. Barrows. pp. 280-285.

The agency of birds in distributing the seeds of certain fleshy fruits is the principal topic of this article, but references to other features of bird food habits are included.

Birds which feed on mulberries. By Dr. C. Hart Merriam. p. 285.

The fact is noted that when mulberries are ripe many insectivorous birds forsake their chief diet for the time to feed upon this luscious fruit. A list of 26 species of birds observed to eat mulberries is given.

1891.

Report of the ornithologist and mammalogist. By C. Hart Merriam. pp. 267-271.

Contains a brief review of the economic investigations of the year, putting especial emphasis upon the importance of the English sparrow problem.

1892.

Economic ornithology. By W. B. Barrows. pp. 193-197.

This takes the place of that section of the report of the chief customarily devoted to a review of the economic work of the year. It contains also, however, a preliminary report on the food of horned larks, based upon the examination of 59 stomachs.

Food habits of the cedar bird (*Ampelis cedrorum*). By F. E. L. Beal. pp. 197-200.

The results reached from the examination of 125 stomachs are as follows: (1) That cedar birds eat a certain amount of insect food at all times when it can be obtained, aggregating in the case of the stomachs examined 17 per cent of the food for the whole year; (2) that the greatest amount of insect food is eaten during the months (especially May) when fruit is most abundant; (3) that the young in the nest are fed to a very great extent upon insect food.

1893.

Food habits of the kingbird or bee martin (*Tyrannus tyrannus*).

By Walter B. Barrows. pp. 233-234.

This report gives the results of the examination of 171 stomachs, particular attention being paid to the bird's relation to honeybees.

1895.

Report of the chief of the Division of Ornithology and Mammalogy.

By C. Hart Merriam. pp. 175-178.

Reference is made to a proposed New York law placing a bounty on English sparrows.

1898.

Report of the acting chief of the Division of Biological Survey. By

T. S. Palmer. pp. 37-42.

Contains general reference to the caterpillar-eating habits of cuckoos and the destruction of weed seeds by sparrows.

1899.

Report of the acting chief of the Division of Biological Survey. By

T. S. Palmer. pp. 59-70.

This report discusses an effort made to reduce the number of English sparrows in the parks of Boston. The proposed introduction of the great titmouse and blue tit of Europe also receives consideration, and comments are made upon the economic status of these birds. The evil results of the introduction of European sparrows, thrushes, blackbirds, and starlings into Australia and New Zealand are cited as examples of what might result were these birds brought into the United States, Hawaii, or Porto Rico.

1900.

Report of the acting chief of the Division of Biological Survey. By

T. S. Palmer. pp. 35-48.

Contains brief references to the nature of the food of a few species, and reviews the Lacey Act, which prohibits the introduction of English sparrow and starling.

1901.

Report of the acting chief of the Division of Biological Survey. By

T. S. Palmer. pp. 151-162.

Three species of birds injurious to fruit in California are mentioned.

1902.

Report of the chief of the Division of Biological Survey. By C. Hart

Merriam. pp. 209-218.

Three species of introduced birds which have proved injurious in Hawaii are named, and a case is recorded in which the great titmouse was denied admission to the United States.

1904.

Report of the chief of the Division of Biological Survey. By C. Hart Merriam. pp. 291-305.

This report mentions bird enemies of the codling moth in California, discusses the relation of birds to honeybees, and comments on the importation of 3 species of injurious birds.

1905.

Report of the chief of the Division of Biological Survey. By C. Hart Merriam. pp. 303-315.

A brief statement of the economic value of horned larks and grosbeaks is included in this report.

1906.

Report of the acting chief of the Bureau of Biological Survey. By Henry W. Henshaw. pp. 397-418.

Includes brief discussion of the following topics: Ravages of geese in California grainfields, birds in relation to the cotton-boll weevil, economic value of eagles, also of grosbeaks, food of wild ducks, and means of attracting birds.

1907.

Report of the chief of the Bureau of Biological Survey. By C. Hart Merriam. pp. 485-505.

This report discusses scale-eating birds, grosbeaks, the English sparrow, and the relation of birds to the cotton-boll weevil.

1908.

Report of the chief of the Bureau of Biological Survey. By C. Hart Merriam. pp. 571-590.

The economic topics receiving consideration in this report are as follows: Relation of birds to the cotton-boll weevil, California birds in relation to the fruit industry, food of wild ducks, food of woodpeckers, mosquito-eating birds, birds in relation to the codling moth, the spread of the English sparrow in southern California, and means of attracting birds. European skylarks and song thrushes imported for liberation were denied admission, and an investigation of the economic status of the starling is announced.

1909.

Report of the chief of the Bureau of Biological Survey. By C. Hart Merriam. pp. 533-551.

The problem of keeping English sparrows out of southern California receives further attention in this report. Other economic subjects considered are the food of woodpeckers, flycatchers, wild ducks, and shorebirds; birds in relation to wheat aphids, to the boll weevil, and to the fruit industry in California; and the exclusion of injurious species from Hawaii.

1910.

Report of the chief of the Bureau of Biological Survey. By H. W. Henshaw. pp. 549-565.

The economic topics dealt with in this report are as follows: Injury to timber by woodpeckers, food of wild ducks and flycatchers, and birds in relation to the gypsy and brown-tail moths.

SCHEDULES.

The series known as schedules, with one exception, consists of blank forms for the recording of data. No. 4, devoted to questions concerning the economic status of the English sparrow, is indexed.

SCHEDULE 4. Schedule on the English sparrow (*Passer domesticus*). By Dr. C. Hart Merriam [1 p., unnumbered, 1886].

Consists wholly of questions on the presence, abundance, relations to other birds, food, and injurious habits of the English sparrow.

YEARBOOKS.

The Yearbook of the United States Department of Agriculture had its origin in a desire to separate papers of a scientific character, with which the annual reports were becoming burdened, from the administrative reports of the various bureaus and divisions. The first Yearbook, that for 1894, was issued in 1895 and this relation of date of publication to date of volume holds throughout the series. The Yearbook consists principally of special reports and papers which are designed to interest and instruct.

In the 17 volumes thus far issued (including 1910) the Biological Survey has furnished 32 articles dealing to some degree with the food of birds.

1894.

Hawks and owls as related to the farmer. By A. K. Fisher, M. D. pp. 215-232. Pls. I-III. figs. 21-24.

This article is a condensation of Bulletin 3 of the Biological Survey. It contains lists of the wholly beneficial, chiefly beneficial, and harmful hawks and owls, as well as those in which harmful and beneficial qualities about balance. The food habits of 32 species are briefly reviewed.

The crow blackbirds and their food. By F. E. L. Beal. pp. 233-248. fig. 25.

This is the most authoritative account of the food of any species of bird, being based upon the examination of 2,258 stomach contents. The paper takes account also of printed and communicated testimony on the food of the crow blackbird. The grains and fruits eaten, animal food, and food of the young are all carefully considered. Depredations on grain and various other injurious traits are admitted, while on the other hand the birds are stated to do incalculable good by destroying insects.

1895.

Four common birds of the farm and garden. By Sylvester D. Judd.
pp. 405-418. figs. 106-109.

The four common birds referred to are the catbird, mockingbird, brown thrasher, and house wren. The range and general habits of each are described; attention is given to any complaints that have been made against the species, and the evidence as to food derived from stomach examination and from experiment are discussed. The verdict is favorable to the brown thrasher and wren, unfavorable to the catbird, and in the case of the mockingbird, from lack of material, judgment is suspended.

The meadow lark and Baltimore oriole. By F. E. L. Beal. pp.
419-430. figs. 110-111.

Although these birds belong to the same family, they have very different habits. The terrestrial meadow lark feeds to a great extent upon grasshoppers, while the most important item of the insect food of the arboreal oriole is caterpillars. The other items of food of both species are fully discussed, and the verdict in each case is in favor of the bird.

Professor Beal points out an error in the calculation on page 422 of the amount saved a township by meadow larks feeding on grasshoppers. The final figure should be about \$356, instead of \$24. This change was made in the reprints.

Erroneous ideas concerning hawks and owls. [By A. K. Fisher.]
p. 590.

Most of this short note is a quotation of the economic classification of the hawks and owls given by Doctor Fisher in the Yearbook for 1894, pp. 217-218.

1896.

Extermination of noxious animals by bounties. By T. S. Palmer.
pp. 55-68.

The history of bounty legislation in the United States, expense of the system, objections to it, and the results accomplished are discussed. As bounties have been paid on several kinds of birds, the economic status of the species affected receives passing notice.

The blue jay and its food. By F. E. L. Beal. pp. 197-206. figs.
40-42.

This is a complete discussion of the range, habits, and economic value of the blue jay. Details are given as to the insect and vegetable food. Experiments to determine preferences of a captive jay are described. Except for the nest-robbing proclivities of the jay, upon which final judgment is not passed, the bird is thought to do far more good than harm.

Erroneous ideas concerning hawks and owls. [By A. K. Fisher.]
p. 628.

Comment under same title in previous Yearbook applies here.

1897.

Birds that injure grain. By F. E. L. Beal. pp. 345-354.

Professor Beal discusses the cause of the increase in numbers of the principal grain-eating birds, outlines the damage done, and gives somewhat extended accounts of the food habits of 5 species, particularly in relation to grain. Four other species are briefly mentioned.

Useful birds and harmful birds. [By Biological Survey.] p. 670.

This is a tabulation of twenty-five species which are decidedly beneficial to agriculture and should be rigidly protected, and of five species which are injurious and unworthy of protection, with a brief statement of principal foods of each.

1898.

The danger of introducing noxious animals and birds. By T. S. Palmer. pp. 87-110. Pl. VIII. figs. 1-6 (1 map).

This paper reviews the experience of various foreign countries with the introduction of certain mammals and birds, points out the evil results of the importation of the English sparrow into the United States, and calls attention to the danger of similar results arising in other cases if introductions are not controlled. The economic status of 11 species of birds is more or less fully discussed.

Birds as weed destroyers. By Sylvester D. Judd, Ph. D. pp. 221-232. Pl. XV. figs. 59-65.

This is a résumé of the seed-eating habits of all the species known to have any importance as destroyers of weed seeds. Some forty species of birds are mentioned.

The name "clay-colored longspur," bottom of page 226, is unidentifiable.

1899.

A review of economic ornithology in the United States. By T. S. Palmer. pp. 259-292. Pls. VI-VIII (1 map).

This article traces briefly the development of American ornithology in general, but it consists largely of a discussion of the study of birds from the standpoint of dollars and cents. The principal topics relating to bird food are: Investigations as to the value of birds, commencement of investigations along modern lines, a period of notable advance in investigations, and work of the Biological Survey. That section of the paper entitled "Measures for the Destruction, Preservation, and Introduction of Birds" also contains comments on the food habits of several species.

1900.

How birds affect the orchard. By F. E. L. Beal, B. S. pp. 291-304. figs. 34-38.

Birds affect orchards directly by stealing fruit, feeding upon buds, flowers, or the inner bark and sap of the trees, and indirectly by destroying mammals and insects injurious to orchards. This article gives brief accounts of the birds most important in these relations.

The food of nestling birds. By Sylvester D. Judd, Ph. D. pp. 411-436. pls. 49-53. figs. 48-56.

In some cases the food of nestling birds is radically different from that of their parents. When this is the case the difference usually consists in the preponderance of animal food, particularly that of a soft nature, in the diet of the young birds. Dr. Judd describes at varying length the food habits of the nestlings of about 80 species of birds. Incidentally, characteristics of the food of many adults are noted. Dr. Judd introduces in this paper his excel-

lent graphic representation, by means of sectors of a circle, of the proportions of various items in the food of birds. Part of these diagrams are made much more effective by the addition of small figures illustrating a typical member of a group within its particular sector. The article includes an estimate of the value of the crops saved daily by the destruction of locusts by nestling birds in eastern Nebraska during the invasions of Rocky Mountain locusts.

1901.

Two vanishing game birds—the woodcock and the wood duck. By A. K. Fisher. pp. 447-458. pls. 63-64. figs. 37-39 (1 map).
Brief notes on the food of each of these species are given.

1902.

Audubon societies in relation to the farmer. By Henry Oldys. pp. 205-218. pls. 21-22. figs. 11-12 (maps).

This article includes a general statement of the economic value of birds, together with a few specific notes on bird food.

1903.

The economic value of the bobwhite. By Sylvester D. Judd, Ph. D. pp. 193-204. pl. 16 (colored).

This very comprehensive account of the bobwhite includes a statement of its range and general habits; treats the bobwhite as a weed and insect destroyer, as an article of food, and as an object of sport; and discusses measures for the preservation of the species. A very full list of the seeds, fruits, insects, and other invertebrates eaten by the bird concludes the article.

It is now stated upon reliable authority that the record quoted on p. 196 to the effect that 47 cotton-boll weevils were eaten by a bobwhite in one morning is based on observations upon a captive bird. The statement has no value, therefore, as an indication of the relation of bobwhite to the boll weevil under normal conditions.

1904.

The relation of birds to fruit growing in California. By F. E. L. Beal. pp. 241-254.

Most of this article is devoted to the discussion of the species injurious to fruit, but some of the chief enemies of fruit pests are briefly mentioned.

Some benefits the farmer may derive from game protection. By T. S. Palmer. pp. 509-520.

Contains a few notes on the protection of useful birds and prevention of the introduction of injurious species.

1905.

Meadow mice in relation to agriculture and horticulture. By D. E. Lantz. pp. 363-376. pls. 38-41. fig. 89.

A full account of the natural enemies is given, which includes notes on many species of birds.

Federal game protection—a five years' retrospect. By T. S. Palmer. pp. 541–562. pl. 70. figs. 113–125 (maps).

This article names three species of birds denied admission to the United States under authority of the Lacey Act.

1906.

Cage-bird traffic of the United States. By Henry Oldys. pp. 165–180. pls. 8–9.

Refers to damage in rice fields by Java sparrows.

Birds that eat scale insects. By W. L. McAtee. pp. 189–198. figs. 1–3.

Previous to the publication of this paper little had been made public concerning the destruction of scale insects by birds. Indeed, currency had been given to a statement that birds never feed upon scales. However, 57 species are recorded as enemies of various scale insects, 29 of them being known to feed upon the black olive scale, one of the most injurious species in the United States.

1907.

Does it pay the farmer to protect birds? By H. W. Henshaw. pp. 165–178. pls. 6–9.

This article discusses, in a general way, the value of the principal groups of insectivorous birds. The habits or items of food of a number of species are mentioned.

The rabbit as a farm and orchard pest. By D. E. Lantz. pp. 329–342. pls. 37–38. fig. 34.

Seventeen species of raptorial birds are mentioned among the natural enemies of rabbits.

1908.

The economic value of predaceous birds and mammals. By A. K. Fisher. pp. 187–194. pls. 1–3.

The notes on bird food in this article relate principally to hawks, owls, herons, and gulls.

Mouse plagues, their control and prevention. By Stanley E. Piper. pp. 301–310. pls. 21–25.

The natural enemies of *Microtus montanus* are given their due share of attention, a few birds being specifically mentioned. A list is also given of birds killed by poisoned grain laid for the mice.

The relations between birds and insects. By F. E. L. Beal. pp. 343–350.

The principal points made in this paper are that birds are a very important check upon insects and that their true function is not so much to destroy this or that insect pest as it is to lessen the numbers of the insect tribe as a whole. While the bulk of the paper consists of a general discussion of the relations between birds and insects, definite notes on the food of a few species are given.

1909.

Plants useful to attract birds and protect fruit. By W. L. McAtee.
pp. 185-196.

This article mentions the plants most useful for attracting fruit-eating birds, and gives lists of species suitable for various sections of the United States. It includes also brief notes on other phases of bird attraction. The favorite foods of a few species of game birds are named.

Pocket gophers as enemies of trees. By David E. Lantz. pp. 209-218. pls. 8-10. fig. 1.

The fact is noted that barn owls and great blue herons are of great value as enemies of pocket gophers.

Introduction of the Hungarian partridge into the United States. By Henry Oldys. pp. 249-258. Pl. 14.

Includes a brief statement of the nature of the food.

INDEX.

Notes relating to a species of bird are brought together under its current scientific name and cross references from the common name, and in some cases from certain once familiar scientific names, are inserted. The scientific names of North American birds correspond with those of the Check-list prepared by a committee of the American Ornithologists' Union, New York, 1910. Subspecies are not separately mentioned, except when the typical subspecies is extralimital or only one subspecies has been treated.

The number of stomachs analyzed is noted in the case of all formal reports, of other original investigations as "Birds of a Maryland Farm" or "Birds of California in Relation to the Fruit Industry," and of those publications including original matter as Farmers' Bulletin 54 and Circular 61. Publications are referred to in the index by the following abbreviations: Bul.—Bulletin, Circ.—Circular, Ent. Circ.—Circular of Division of Entomology, F. Bul.—Farmers' Bulletin, Fauna—N. A. Fauna, Rept.—Annual Report, and Ybk.—Yearbook. The particular bulletin, circular, farmers' bulletin, or fauna is designated by its number, the report or yearbook by the year for which it was issued. Bold-faced figures indicate the pages containing the principal account. The other pages usually contain short notes or merely incidental mention of the food.

A.

Acanthis hornemanni exilis—Hoary redpoll.

Feeding on aments of alder, Fauna 24, p. 73; seeds of alders (*Alnus incana* and *A. alnobetula*), canoe birch (*Betula papyrifera*), and dwarf birch (*Betula nana*), Fauna 27, p. 418.

Acanthis linaria—Redpoll.

Feeding on weed seeds, Ybk. 1898, pp. 222, 229, 230.

Accipiter atricapillus, see *Astur atricapillus*.

Accipiter cooperi—Cooper's hawk.

Brief account, Bul. 31, pp. 45, 46; Bul. 38, p. 38; Circ. 61, pp. 3, 17, 18; Ybk. 1894, pp. 218, **231-232**; Ybk. 1900, p. 429.

Feeding on Beechey's spermophile, Fauna 7, p. 36; bobwhite, Bul. 21, p. 22; birds, Fauna 3, pp. 38, 90; Ybk. 1908, p. 192; Canada grouse, Fauna 22, p. 106; English sparrow,

Accipiter cooperi—Continued.

Bul. 1, p. 32; field mice, Bul. 31, pp. 45, 46; poultry, Bul. 6, p. 39; Bul. 21, p. 22; Ybk. 1908, p. 192; rabbits, Ybk. 1907, p. 336; ruffed grouse, Bul. 24, p. 28; sparrows, Bul. 15, p. 36; spermophiles, Bul. 4, pp. 16-17.

Food at Marshall Hall, Bul. 17, pp. 19, **50-51**, 54, 110.

Food of nestlings, Ybk. 1900, p. 429.

Formal report, Bul. 3, pp. 15, 16, **38-43**, 175 (133 stomachs); Rept. 1887, pp. 402, 405 (46 stomachs).

Injurious, Bul. 12, pp. 30, 36, 49; Bul. 12 (rev.), pp. 32, 33, 43, 58; Bul. 38, p. 10; Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670.

Accipiter velox—Sharp-shinned hawk.

Brief account, Bul. 31, pp. 45, 46; Bul. 38, p. 38; Circ. 61, pp. 3, **17-18** (107 stomachs); Ybk. 1894, pp. 218, **231, 232**; Ybk. 1900, p. 429.

Feeding on birds, Ybk. 1908, p. 192; bobwhite, Bul. 21, p. 22; English

Accipiter velox—Continued.

sparrow, Bul. 1, p. 32; field mice, Bul. 31, pp. 45, 46; flicker and Gambel's (intermediate) sparrow, Fauna 19, p. 73; pileolated warbler (*Wilsonia pusilla pileolata*), Fauna 5, p. 94; poultry, Ybk. 1908, p. 192; sparrows, Bul. 15, p. 36; thrush, Fauna 19, p. 72; woodcock, Ybk. 1901, p. 450.

Food at Marshall Hall, Bul. 17, pp. 19, 51-52, 54, 110.

Formal report, Bul. 3, pp. 15, 16, 32-37, 38, 43 (159 stomachs); Rept. 1887, pp. 402, 404 (48 stomachs).

Injurious, Bul. 12, pp. 30, 36, 49; Bul. 12 (rev.), pp. 32, 33, 43, 58; Bul. 38, p. 10; Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670.

Acredula caudata, see *Ægithalos caudatus*.

Acridotheres tristis—Common myna.

Economic status, introduction dangerous, etc., Ybk. 1898, pp. 90, 103-104, 107, 109.

Injurious in Hawaii, Bul. 12 (rev.), p. 87; Rept. 1902, p. 213; Ybk. 1899, p. 290.

Protection denied in Hawaii, Bul. 12 (rev.), p. 87.

Actitis macularia—Spotted sandpiper.

Brief account, Bul. 38, p. 32.

Feeding on army worms, Circ. 79, p. 6; cabbage worms, Circ. 79, pp. 7-8; crayfishes, Circ. 79, p. 6; cutworms, Circ. 79, pp. 7-8; grasshoppers, Circ. 79, p. 2; green flies and squash bugs, Circ. 79, pp. 7-8.

Food at Marshall Hall, Bul. 17, pp. 19, 23, 24, 34, 38, 83.

Food of nestlings, Ybk. 1900, p. 433.

Ægialitis hiaticula—Ringed plover; occurs in Greenland, Circ. 79, p. 2, error for *Ægialitis meloda*, which see.

Ægialitis meloda—Piping plover.

Feeding on grasshoppers, Circ. 79, p. 2.

Ægialitis nivosa—Snowy plover.

Feeding on *Ephydra hians*, Fauna 7, p. 25.

Ægialitis semipalmata—Ringneck.

Feeding on grasshoppers and mosquitoes, Circ. 79, p. 2.

Ægithalos caudatus—Long-tailed titmouse.

Feeding on scale insects, Ybk. 1906, p. 191.

Agelaius gubernator californicus—Bicolored redwing blackbird.

Food in California, Bul. 34, pp. 56-59 (198 stomachs).

Formal report, Bul. 13, pp. 9, 10, 44-45 (61 stomachs).

Agelaius phoeniceus—Redwing blackbird.

Bounty laws, Ybk. 1896, p. 57.

Brief account, Bul. 12, p. 21; Bul. 38, p. 57; F. Bul. 54, pp. 19-21 (725 stomachs); F. Bul. 54 (rev.), pp. 24-26 (1,083 stomachs); Ybk. 1897,

Agelaius phoeniceus—Continued.

pp. 345, 349-351, 353; Ybk. 1900, pp. 422-423.

Damage done, Bul. 12 (rev.), p. 28; Bul. 15, p. 17; Bul. 38, p. 57; Ent. Circ. 20 [p. 2]; Rept. 1886, pp. 242, 246-249; Rept. 1887, pp. 428, 429, 430, 431, 454, 455, 456; Rept. 1900, p. 44; Ybk. 1897, pp. 345, 349-351, 353; Ybk. 1898, p. 230.

Feeding on boll weevils, Bul. 22, pp. 10-11, 16; Bul. 25, pp. 8, 9, 12, 21; Bul. 29, pp. 6, 7, 18, 29, 30; Bul. 38, p. 57; Circ. 64, pp. 3, 5; grain, Fauna 7, p. 74; Rept. 1887, pp. 428, 429, 430, 431, 454, 455, 456; Rept. 1900, p. 44; Ybk. 1897, pp. 345, 349-351, 353; Ybk. 1898, p. 230; rice, Bul. 15, p. 17; Bul. 22, pp. 11, 16; Bul. 38, p. 57; Circ. 5 [p. 1]; Rept. 1886, pp. 234, 242, 246-249; weed seeds, Bul. 29, p. 8; Ybk. 1898, p. 230.

Food at Marshall Hall, Bul. 17, pp. 20, 23, 24, 32, 35, 38, 40, 69, 70, 71, 77, 95-96, 111 (8 stomachs).

Food in California, Bul. 34, p. 59 (12 stomachs).

Food of nestlings, Ybk. 1900, pp. 422-423.

Formal report, Bul. 13, pp. 8, 9, 11, 33-44 (1,083 stomachs).

Other notes, Bul. 15, p. 29; Bul. 22, pp. 11, 16.

References to studies of food habits, Ybk. 1899, p. 266.

Request for information on economic relations, Ent. Circ. 20 [p. 2]; Circ. 5 [p. 1]; Rept. 1886, p. 234.

Agelaius tricolor—Tricolored redwing blackbird.

Food in California, Bul. 34, p. 59 (16 stomachs).

Aix sponsa—Wood duck.

Brief account, Bul. 38, p. 20; Ybk. 1901, p. 455.

Food of nestlings, Ybk. 1900, p. 435.

Vegetable food, Circ. 81, pp. 1, 2.

Alauda arvensis—Skylark.

Admission denied, Rept. 1908, p. 581.

Brief account, Bul. 23, p. 11.

Economic status, introduction dangerous, etc., Ybk. 1898, pp. 90, 106, 107, 109.

Injurious in New Zealand, Ybk. 1909, p. 257.

Pulling grain, Bul. 1, p. 341.

Sale in market, Bul. 23, p. 11.

Aluco flammeus—Old-world barn owl.

Enemy of field mice, Bul. 31, pp. 46-47, 48.

Aluco pratincola—American barn owl.

Beneficial, Ybk. 1895, p. 590; 1896, p. 628; Ybk. 1897, p. 670.

Brief account, Bul. 31, pp. 46, 47, 48; Bul. 38, p. 41; Circ. 61, pp. 3,

Aluco pratincola—Continued.

10-11 (200 pellets); Ybk. 1894, pp. 217, 223-224; Ybk. 1900, pp. 301, 430.

Feeding on bats, Fauna 7, p. 42; black rat, Bul. 33, pp. 34-35; Brewer's blackbird, Bul. 5, p. 21; Ybk. 1909, p. 217; brown rat, Bul. 33, pp. 34-35; chipmunk (dead), Fauna 7, p. 42; field mice, Bul. 31, pp. 46, 47, 48; Ybk. 1905, pp. 371, 372; jackrabbit, Bul. 8, p. 44; pocket gopher, Bul. 5, pp. 20-21; Ybk. 1909, p. 217; (dead) Fauna 7, p. 42; spermophiles, Bul. 4, p. 16.

Food of nestlings, Ybk. 1900, p. 430.
Formal report, Bul. 3, pp. 11, 13-14, 132-139 (39 stomachs); Rept. 1887, p. 417 (7 stomachs).

Relation to orchards, Ybk. 1900, p. 301.

Amazilia graysoni, see Amizillis graysoni.

Amizillis graysoni—Grayson's hummingbird.

Insect food and feeding habits, Fauna 14, p. 45.

Amazona oratrix—Double yellow-headed parrot.

Feeds on pods of *Pithecolobium dulce* and other fruits, Fauna 14, pp. 39-40.

Ammodramus caudacutus, see Passerherbulus caudacutus.

Ammodramus henslowi, see Passerherbulus henslowi.

Ammodramus maritimus, see Passerherbulus maritimus.

Ammodramus nelsoni, see Passerherbulus nelsoni.

Ammodramus savannarum australis—Grasshopper sparrow.

Feeding on weed seeds, Ybk. 1898, pp. 222, 223, 226, 227, 228.

Food at Marshall Hall, Bul. 17, pp. 13, 14, 26, 30, 32, 35, 38, 40, 44, 49, 70, 71, 72, 73, 97, 110 (10 stomachs).

Food of adults and nestlings, Ybk. 1900, p. 419.

Formal report, Bul. 15, pp. 21, 23, 24, 28, 34, 45, 61-63, 91, 92 (170 stomachs).

Ammodramus savannarum passerinus, see Ammodramus savannarum australis.

Ampelis cedrorum, see Bombycilla cedrorum.

Ampelis garrulus, see Bombycilla garrula.

Anas boschas, see Anas platyrhynchos.

Anas obscura, see Anas rubripes.

Anas platyrhynchos—Mallard.

Brief account, Bul. 38, p. 17.

Feeding on grasshoppers, Fauna 7, p. 15.

Food of nestlings, Ybk. 1900, p. 435.

Vegetable food, Circ. 81, pp. 1, 2, 8.

Anas rubripes—Black duck.

Vegetable food, Circ. 81, pp. 1, 2, 8.

Anhinga anhinga—Water-turkey.

Harmless, Bul. 38, p. 15.

Anthus pensylvanicus, see Anthus rubescens.

Anthus rubescens—Pipit.

Brief account, Bul. 38, p. 84.

Feeding on boll weevil, Bul. 22, pp. 8-9, 16; Bul. 25, pp. 9, 14, 21; Bul. 29, pp. 6, 22-23, 30; Bul. 38, pp. 9, 84; Circ. 57, p. 4; Circ. 64, pp. 4, 5; Rept. 1908, p. 576.

Antrostomus carolinensis—Chuck-will's-widow.

Brief account, Bul. 38, p. 50.

Antrostomus vociferus—Whippoorwill.

Brief account, Bul. 38, p. 50.

Food at Marshall Hall, Bul. 17, p. 19.

Aphelocoma californica—California jay.

Brief account, F. Bul. 54 (rev.), pp. 19-21 (141 stomachs).

Feeding on scale insects, Ybk. 1906, p. 194.

Food in California, Bul. 34, pp. 8, 47, 50-56 (326 stomachs).

Relation to fruit in California, Bul. 30, p. 13; Rept. 1901, p. 153; Ybk. 1904, pp. 246, 248-250.

Aphelocoma woodhousei—Woodhouse's jay.

Feeding on piñon nuts, Fauna 3, pp. 39, 94.

Aquila chrysaetos—Golden eagle.

Brief account, Circ. 61, pp. 3, 13, 14; Rept. 1887, p. 413; Ybk. 1894, pp. 217, 227.

Compiled information, Bul. 27, pp. 20-31.

Equally beneficial and injurious, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Feeding on Abert's squirrel (*Sciurus aberti*), Fauna 3, p. 90; Beechey's spermophile (*Citellus beecheyi*), Circ. 76, pp. 7, 8; dusky grouse (probably), Fauna 7, p. 39; jack rabbits, Bul. 8, p. 44; (*Lepus texianus*) Fauna 25, p. 154; lambs of mountain sheep (probably), Fauna 30, p. 60; prairie dogs (watching for), Fauna 3, p. 90; rabbits, Ybk. 1907, p. 336; spermophiles, Bul. 4, p. 16; varying hares, Fauna 27, p. 359; woodchucks (probably), Fauna 7, p. 39; (*Marmota monax canadensis*) Fauna 27, p. 359.

Formal report, Bul. 3, pp. 15, 93-97 (6 stomachs).

Protected in some States, Ybk. 1899, p. 266.

Archibuteo ferrugineus—Squirrel hawk.

Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670.

Brief account, Bul. 3, pp. 11, 91-93; Circ. 61, pp. 3, 4-6; Ybk. 1894, pp. 217, 219, 220.

Feeding on brown rat, Bul. 33, p. 34; rabbits, Ybk. 1907, p. 336; spermophiles, Bul. 4, pp. 15, 16.

Other notes, Bul. 31, p. 44.

- Archibuteo lagopus lagopus*—Old-world rough-legged hawk.
Feeding on field mice, Bul. 31, p. 44.
- Archibuteo lagopus sancti-johannis*—Rough-legged hawk.
Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628.
Brief account, Bul. 31, p. 44; Circ. 61, pp. 3, 4-5; Ybk. 1894, pp. 217, 219-220; Ybk. 1900, p. 301.
Feeding on brown rat, Bul. 33, p. 34; field mice, Bul. 31, p. 44; Ybk. 1905, p. 371; (*Microtus montanus*) F. Bul. 352, p. 22; ground squirrel (*Citellus plesius*, probably), Fauna 30, p. 88; rabbits, Ybk. 1907, p. 336.
Formal report, Bul. 3, pp. 11, 86-91, 92 (49 stomachs); Rept. 1887, p. 413 (28 stomachs).
Relation to orchards, Ybk. 1900, p. 301.
- Archilochus colubris*—Ruby-throated humming bird.
Food at Marshall Hall, Bul. 17, pp. 19, 39, 91.
Food of adults and nestlings, Ybk. 1900, p. 427.
- Ardea cærulea*, see *Florida cærulea*.
- Ardea candidissima*, see *Egretta candidissima*.
- Ardea herodias*—Great blue heron.
Brief account, Bul. 38, p. 25; Ybk. 1908, p. 193.
Feeding on field mice, Bul. 31, p. 52; Ybk. 1909, p. 217; pocket gophers, Ybk. 1908, p. 193; Ybk. 1909, p. 217.
Food at Marshall Hall, Bul. 17, pp. 19, 53.
Injurious to fish, exempted from protection in Vermont, Bul. 12 (rev.), p. 43.
- Ardea virescens*, see *Butorides virescens*.
- Ardetta exilis*, see *Ixobrychus exilis*.
- Arenaria interpres*—Turnstone.
Feeding on beetles and other insects, Fauna 27, p. 336; crowberries, Ybk. 1903, p. 377; grasshoppers, Circ. 79, p. 2.
Feeds on caterpillars and cutworms, protected in Hawaii, Bul. 12 (rev.), p. 87.
- Arquatella maritima*—Purple sandpiper.
Feeding on Nereis, Circ. 79, p. 8.
Food of adults and nestlings, Ybk. 1900, p. 432.
- Asio accipitrinus*, see *Asio flammeus*.
- Asio flammeus*—Short-eared owl.
Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670;
Brief account, Bul. 31, pp. 47, 48, 53; Circ. 61, pp. 3, 11; Ybk. 1894, pp. 217, 224-225.
Feeding on cotton rat (*Sigmodon hispidus texianus*), Fauna 25, p. 117; field mice, Bul. 31, pp. 47, 48, 53; Ybk. 1905, pp. 371, 372; (*Microtus* *Asio flammeus*—Continued.
drummondi) Fauna 27, p. 368; mice, Fauna 19, p. 76; rabbits, Ybk. 1907, p. 336; shrews, Fauna 19, p. 76.
Food at Marshall Hall, Bul. 17, pp. 54-55, 86.
Formal report, Bul. 3, pp. 11, 14, 145-149 (101 stomachs); Rept. 1887, 418 (45 stomachs); Rept. 1888, pp. 496-498 (50 stomachs).
- Asio otus*—Old-world long-eared owl.
Brief account, feeding on field mice, Bul. 31, pp. 47, 48.
- Asio wilsonianus*—American long-eared owl.
Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670.
Brief account, Bul. 31, pp. 47, 48; Bul. 38, pp. 41-42; Circ. 61, pp. 3, 11; Ybk. 1894, pp. 217, 224; Ybk. 1900, p. 430.
Feeding on field mice, Bul. 31, pp. 47, 48; Ybk. 1905, p. 371, (*Microtus drummondi*) Fauna 27, p. 367; rabbits, Ybk. 1907, p. 336; red-backed mice (*Eutamias dawsoni*), Fauna 27, p. 367.
Formal report, Bul. 3, pp. 11, 14, 140-145, 165 (107 stomachs); Rept. 1887, pp. 417-418 (47 stomachs).
- Astragalinus psaltria hesperophilus*—Green-backed goldfinch.
Feeding on seeds of wild sunflower, Fauna 7, p. 84.
Food in California, Bul. 34, pp. 73-75, 85 (476 stomachs).
- Astragalinus tristis*—Goldfinch.
Brief account, Bul. 38, p. 61.
Damage to oats, Bul. 15, p. 11.
Feeding on mulberries, Rept. 1890, p. 285; weed seeds, Bul. 15, pp. 39, 42; Ybk. 1898, pp. 222, 224, 225, 229, 232.
Food at Marshall Hall, Bul. 17, pp. 14-15, 26, 69, 71, 75-76, 79, 97 (11 stomachs).
Food in California, Bul. 34, pp. 71-73, 85 (84 stomachs); [also in East, p. 71].
- Astur atricapillus*—Goshawk.
Brief account, Circ. 61, pp. 3, 17; Ybk. 1894, pp. 218, 231; Ybk. 1900, p. 429.
Feeding on bobwhite, Bul. 21, p. 22; ground squirrel (probably), Fauna 19, p. 73; poultry, Bul. 21, p. 22; Fauna 5, p. 94; ptarmigan, Fauna 27, p. 354; (*Lagopus lagopus*) Fauna 27, p. 346; rabbits, Ybk. 1907, p. 336; ruffed grouse, Bul. 24, p. 28; Fauna 27, p. 354; squirrel (*Sciurus*), Fauna 21, p. 76; varying hare, Fauna 27, p. 353.
Formal report, Bul. 3, pp. 15, 43-46, 175 (28 stomachs); Rept. 1887, 405 (6 stomachs).

Astur atricapillus—Continued.

Injurious, Bul. 12, pp. 30, 49; Bul. 12 (rev.), pp. 33, 58; Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670; Ybk. 1908, p. 192.

Other notes, Fauna 5, pp. 18, 94.

Asturina plagiata—Mexican goshawk.

Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 3, pp. 11, 85–86.

Asyndesmus lewisi—Lewis's woodpecker.

Feeding on grasshoppers, Fauna 7, p. 50.

Food in California, Bul. 34, pp. 28–29 (23 stomachs).

Formal report, Bul. 37, pp. 10, 45–47 (59 stomachs).

Asyndesmus torquatus, see *Asyndesmus lewisi*.Auklet, Paroquet, see *Phaleris psittacula*.Avocet, see *Recurvirostra americana*.**B.***Bæolophus atricristatus*—Black-crested titmouse.

Feeding on boll weevil, Bul. 22, pp. 9, 16; Bul. 25, pp. 9, 14, 15, 21; Bul. 29, pp. 6, 22, 30; Circ. 64, p. 5.

Bæolophus bicolor—Tufted titmouse.

Brief account, Bul. 38, p. 89; F. Bul. 54 (rev.), p. 44 (a mere reference). Feeding on boll weevil, Bul. 29, pp. 6, 22, 28, 30; Circ. 64, pp. 4, 5; scale insects, Ybk. 1906, p. 197.

Food habits at Marshall Hall, Bul. 17, pp. 20, 61, 107.

Bæolophus inornatus—Plain titmouse.

Feeding on noxious insects. Ybk. 1904, p. 253; scale insects. Ybk. 1906, p. 194.

Food in California, Bul. 30, pp. 68–70 (76 stomachs).

Bæolophus wollweberi—Bridled titmouse.

Feeding on scale insects, Ybk. 1906, p. 197.

Baldpate, see *Mareca americana*.*Bartramia longicauda*—Upland plover.

Brief account, Bul. 38, pp. 31–32.

Economic value, Bul. 22, pp. 15–16; Circ. 79, p. 6.

Feeding on billbugs, Circ. 79, p. 6; boll weevil, Bul. 29, pp. 6, 7, 11, 20, 29, 30; Bul. 38, p. 32; Circ. 64, pp. 2, 5; Circ. 79, p. 6; click beetles, clover leaf weevil, clover root weevil, corn-leaf beetle, cotton worm, cotton cutworm, cowpea weevil, Circ. 79, p. 6; crane flies, Circ. 79, p. 4; crayfishes, cutworms, grapevine colaspis, Circ. 79, p. 6; grasshoppers, Circ. 79, p. 2; Fauna 27, p. 328; wireworms, Circ. 79, p. 6.

Bee martin, see *Tyrannus tyrannus*.Bengalee, see *Uroloncha acuticauda*.Bittern, see *Botaurus lentiginosus*.

Least, see *Ixobrychus exilis*.

Blackbird, Bicolored redwing, see *Agelaius gubernator californicus*.

Boat-tailed, see *Megaquiscalus major*.

Brewer's, see *Euphagus cyanocephalus*.

Crow, see *Quiscalus quiscula*.

European, see *Turdus merula*.

Redwing, see *Agelaius phoeniceus*.

Rusty, see *Euphagus carolinus*. Tricolored redwing, see *Agelaius tricolor*.

Yellow-headed, see *Xanthocephalus xanthocephalus*.

Blackjack, see *Marila collaris*.Bluebill, Big, see *Marila marila*.

Little, see *Marila affinis*.

Bluebird, see *Sialia sialis*.

Mountain, see *Sialia currucoides*.

Western, see *Sialia mexicana occidentalis*.

Bobolink, see *Dolichonyx oryzivorus*.Bobwhite, see *Colinus virginianus*.

Masked, see *Colinus ridgwayi*.

Bombycilla cedrorum—Cedar bird.

Brief account, Bul. 38, p. 72; F. Bul. 54, pp. 31–32 (152 stomachs); F. Bul. 54 (rev.), pp. 38–39 (152 stomachs); Ybk. 1900, p. 304.

Feeding on cherries, Bul. 32, p. 91; Bul. 34, p. 55; Ybk. 1907, p. 175; grape (*Vitis californica*), Fauna 7, p. 113; insects, Fauna 27, p. 459; mahaleb cherry (*Prunus mahaleb*), Bul. 32, p. 65; mulberries, Bul. 32, pp. 64, 65; Fauna 7, p. 113; Rept. 1890, p. 285; scale insects, Ybk. 1906, p. 197.

Food at Marshall Hall, Bul. 17, pp. 17, 23, 24, 30, 43, 56, 59, 60, 62, 99 (5 stomachs).

Food of nestlings, Ybk. 1900, pp. 417, 436.

Formal report, Rept. 1892, pp. 197–200 (125 stomachs).

Frugivorous habits (other than above noted), Bul. 30, p. 20; Rept. 1890, p. 281.

Reference to studies of food habits, Ybk. 1899, p. 266.

Relation to orchards, Ybk. 1900, p. 304.

Bombycilla garrula—Bohemian waxwing.

Feeding on berries and insects, Fauna 19, p. 89.

Bonasa umbellus—Ruffed grouse.

Brief account, Ybk. 1909, p. 194.

Feeding on buds, Ybk. 1907, p. 172; of balsam poplar, Fauna 27, pp. 340, 342; of *Lepargyrea* and *Salix*, Fauna 27, pp. 341, 342; catkins of willows, Fauna 27, p. 341; foliage, Bul. 21, p. 52; of *Populus balsam-*

Bonasa umbellus—Continued.

ifera and *Pyrola*, Fauna 27, p. 342; of willow, Fauna 27, 341; grass seeds, Fauna 27, p. 341; heads and shoots of *Equisetum*, Fauna 27, pp. 341, 342; potato beetle, Bul. 32, p. 47; rose hips, Fauna 27, p. 341; weed seeds, Ybk. 1898, p. 231.

Formal report, Bul. 24, pp. 17, 23, 25-38 (208 stomachs).

Booby, Blue-footed, see *Sula nebouxi*.**Botaurus lentiginosus**—Bittern.

Brief account, Bul. 38, p. 24; Ybk. 1908, p. 193.

Feeding on field mice, Bul. 31, p. 52; frogs and large beetles, Fauna 27, p. 311; injurious rodents, Ybk. 1908, p. 193.

Branta canadensis—Canada goose.

Brief account, Bul. 38, p. 23.

Feeding on berries of *Empetrum nigrum*, Fauna 27, p. 306.

Bubo virginianus—Great horned owl.

Bounty laws, Ybk. 1899, p. 281.

Brief account, Bul. 31, p. 49; Bul. 38, pp. 43-44; Circ. 61, pp. 3, 13, 15-16, 18; Ybk. 1894, pp. 217, 227, 229; Ybk. 1900, pp. 300-301, 430.

Equally beneficial and injurious, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Feeding on brown bat (*Vespertilio fuscus*), Fauna 25, p. 211; brown rat, Bul. 33, p. 35; field mice, Bul. 31, p. 49; Fauna 5, pp. 19, 96; Ybk. 1905, p. 371; Ybk. 1908, p. 188; (*Microtus drummondi*) Fauna 27, pp. 372, 374; ground squirrels, Fauna 19, p. 76; jack rabbits, Bul. 8, p. 44; (*Lepus texianus*) Fauna 25, p. 154; lemming mouse (*Phenacomys orophilus*), Fauna 5, pp. 19, 96; pocket gophers, Bul. 5, pp. 20-21; (*Cratogeomys castanops*) Fauna 25, p. 133; (*Thomomys*) Fauna 5, pp. 19, 96; poultry, Bul. 2, p. 122; Bul. 21, p. 22; rabbits, Bul. 2, p. 122; Fauna 19, p. 76; Ybk. 1900, pp. 300-301; Ybk. 1907, p. 336; Ybk. 1908, p. 188; (*Lepus arizonæ minor*) Fauna 25, p. 159; red squirrels, Fauna 19, p. 76; (*Sciurus hudsonicus*) Fauna 27, p. 372; ruffed grouse, Bul. 24, p. 28; scorpion, Fauna 7, p. 43; shrews (*Sorex personatus*), Fauna 27, p. 372; skunks, Bul. 2, p. 122; (*Spilogale leucoparia*) Fauna 25, p. 198; spermophiles, Bul. 4, pp. 16-17; varying hares (*Lepus americanus*), Fauna 27, pp. 373, 374; water beetles (*Dytiscus dauricus*), Fauna 27, p. 373; white-footed mice, Fauna 5, pp. 19, 96; (*Peromyscus arcticus*) Fauna 27, p. 372; wood rats (*Neotoma micropus*) Fauna 25, p. 112.

Bubo virginianus—Continued.

Food at Marshall Hall, Bul. 17, pp. 19, 52, 54, 86, 110.

Food of nestlings, Ybk. 1900, pp. 430-431.

Formal report, Bul. 3, pp. 15, 174-182 (127 stomachs); Rept. 1887, pp. 402, 421 (30 stomachs).

Injurious, Bul. 12, pp. 30, 36, 49; Bul. 12 (rev.), pp. 32, 33, 43, 58; Ybk. 1907, p. 167.

Other notes, Fauna 5, p. 18.

Relation to orchards, Ybk. 1900, pp. 300-301.

Bufflehead, see *Charitonetta albeola*.

Bunting, Indigo, see *Passerina cyanea*.

Painted, see *Passerina ciris*.

Snow, see *Plectrophenax nivalis*.

Yellow, see *Emberiza citrinella*.

Bush tit, see *Psaltiriparus minimus*.

Butcher bird, Blg, see *Lanius borealis*.

European great, see *Lanius excubitor*.

Little, see *Lanius ludovicianus*.

Buteo abbreviatus—Zone-tailed hawk.

Formal report, Bul. 3, p. 71 (5 stomachs).

Buteo albicaudatus sennetti—Sennett's white-tailed hawk.

Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 3, pp. 11, 72.

Feeding on rabbits, Ybk. 1907, p. 336.

Buteo borealis—Red-tailed hawk.

Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 31, p. 43; Bul. 38, p. 38; Circ. 61, pp. 3, 6-7; Rept. 1888, p. 480; Ybk. 1894, pp. 217, 220-221; Ybk. 1900, p. 429.

Feeding on brown rat, Bul. 33, p. 34; chipmunks (*Tamias cinereicollis* and *T. lateralis*), Fauna 3, p. 90; dove (attempt to pick up wounded one), Fauna 7, p. 37; field mice, Bul. 31, p. 43; Ybk. 1905, p. 371; Ybk. 1908, p. 187; (*Microtus montanus*) F. Bul. 352, p. 22; grasshoppers, Bul. 3, p. 76; Fauna 7, p. 37; ground squirrel, Fauna 19, p. 73; horned larks, Bul. 23, p. 12; jack rabbits, Bul. 8, p. 44; Jerusalem cricket (*Stenopelmatus*), lizards (*Cnemidophorus tigris* and *Sauromalus ater*), Fauna 7, p. 37; (iguanas) Fauna 14, p. 37; pocket gophers, Bul. 5, p. 20; (*Thomomys*) Fauna 7, p. 37; potato beetle, Bul. 32, p. 47; rabbits, Ybk. 1907, p. 336; (*Lepus graysoni*) Fauna 14, pp. 17, 37; spermophiles, Bul. 4, pp. 15, 16, 17; (*Spermophilus tereticaudus*) Fauna 7, p. 37; (*Spermophilus townsendi*) Fauna 5, p. 94; squirrel

Buteo borealis—Continued.

(*Schurus aberti*), Fauna 3, p. 90; varying hares (apparently), Fauna 27, p. 356.

Food at Marshall Hall, Bul. 17, pp. 19, 54.

Food of nestlings, Ybk. 1900, p. 429.

Formal report, Bul. 3, pp. 11, 12, 48-62, 87 (562 stomachs); Rept. 1887, pp. 405-410 (311 stomachs).

Buteo brachyurus—Short-tailed hawk.

Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 3, pp. 11, 83-84.

Buteo buteo—Common old-world buzzard hawk.

Feeding on field mice, Bul. 31, p. 44.

Buteo latissimus, see **Buteo platypterus**.**Buteo lineatus**—Red-shouldered hawk.

Beneficial, Bul. 12, p. 30; Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670.

Brief account, Bul. 12, p. 30; Bul. 12 (rev.), p. 33; Bul. 31, p. 43; Bul. 38, p. 39; Circ. 61, pp. 3, 6, 7-8; Ybk. 1894, pp. 217, 220, 221; Ybk. 1900, p. 429.

Feeding on brown rat, Bul. 33, p. 34; field mice, Bul. 31, p. 43; Ybk. 1905, p. 371; frogs (watching for), Fauna 7, p. 38; horned larks, Bul. 23, p. 12; rabbits, Ybk. 1907, p. 336; ruffed grouse, Bul. 24, p. 28.

Food at Marshall Hall, Bul. 17, pp. 19, 54, 86.

Formal report, Bul. 3, pp. 11, 12, 62-70 (220 stomachs); Rept. 1887, pp. 410-412 (102 stomachs).

Buteo platypterus—Broad-winged hawk.

Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 31, p. 43; Bul. 38, p. 39; Circ. 61, pp. 3, 9; Ybk. 1894, pp. 217, 222-223.

Feeding on brown rat, Bul. 33, p. 34; field mice, Bul. 31, p. 43; Ybk. 1905, p. 371.

Food at Marshall Hall, Bul. 17, pp. 19, 32, 86, 101.

Food of nestlings, Ybk. 1900, p. 429.

Formal report, Bul. 3, pp. 11, 13, 79-83 (65 stomachs); Rept. 1887, pp. 412-413 (22 stomachs).

Buteo swainsoni—Swainson's hawk.

Beneficial, Bul. 12, p. 30; Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670.

Brief account, Bul. 12, p. 30; Bul. 12 (rev.), p. 33; Bul. 31, p. 43; Circ. 61, pp. 3, 8-9; Ybk. 1894, pp. 217, 222.

Feeding on brown rat, Bul. 33, p. 34; field mice, Bul. 31, p. 43; (*Microtus montanus*) F. Bul. 352, p. 22; grasshoppers, Fauna 5, p. 95; Ybk.

Buteo swainsoni—Continued.

1895, p. 422; Ybk. 1907, p. 166; (*Camnula pellucida*) Fauna 7, p. 38; rabbits, Ybk. 1907, p. 336; spermophiles, Bul. 4, pp. 15, 16, 17.

Formal report, Bul. 3, pp. 11, 12, 13, 72-79 (18 stomachs); Rept. 1887, p. 412 (4 stomachs).

Butorides virescens—Green heron.

Brief account, Bul. 38, p. 26.

Food at Marshall Hall, Bul. 17, pp. 19, 23, 24, 53, 81.

Food of nestlings, Ybk. 1900, p. 435.

Injurious to fish, exempt from protection in Alabama and Pennsylvania, Bul. 12, p. 36; Bul. 12 (rev.), p. 43.

Buzzard, Black, see *Catharista urubu*.

Turkey, see *Cathartes aura septentrionalis*.

Buzzard hawk, Common, see **Buteo buteo**.

Rough-legged, see *Archibuteo lagopus lagopus*.

C.

Calcarius lapponicus—Lapland longspur.

Feeding on weed seeds, Ybk. 1898, p. 226.

Formal report, Bul. 15, pp. 45, 54-55 (113 stomachs).

Calcarius ornatus—Chestnut-collared longspur.

Feeding on weed seeds, Ybk. 1898, p. 226.

Pulling wheat, Bul. 23, p. 16.

Calcarius pictus—Smith's longspur.

Feeding on weed seeds, Ybk. 1898, p. 226.

Callipepla squamata—Scaled quail.

Formal report, Bul. 21, pp. 61-63 (47 stomachs).

Campephilus principalis—Ivory-billed woodpecker.

Brief account, Bul. 37, pp. 62-63.

Useful, Bul. 38, p. 46.

Canachites canadensis—Spruce grouse.

Feeding on bearberries (*Arctostaphylos uva-ursi*), Fauna 27, p. 338; blueberries, Fauna 21, p. 75; (*Vaccinium uliginosum*), fern (*Cryptogramma acrostichoides*), Fauna 27, p. 338; heads of *Equisetum*, Fauna 21, p. 75; highbush cranberries (*Viburnum*), Fauna 21, p. 75; Fauna 30, p. 86; mountain cranberries (*Vitis-idaea vitis-idaea*), Fauna 24, p. 65; Fauna 27, p. 338; pine needles (*Pinus divaricata*), snails (*Lymanea palustris*), Fauna 27, p. 338; spruce needles, Fauna 21, p. 75; Fauna 24, p. 65; (*Picea canadensis*) Fauna 27, p. 338.

Formal report, Bul. 24, pp. 38-40, 42 (8 stomachs).

Canachites franklini—Franklin's grouse.

Brief account, Bul. 24, p. 40.

Canvasback, see *Marila valisineria*.

- Capercaillie, see *Tetrao urogallus*.
 Caracara, see *Polyborus cheriway*.
 Carancho, see *Polyborus tharus*.
Cardinalis cardinalis—Cardinal.
 Brief account, Bul. 38, p. 67; F. Bul. 456, pp. 9, 12.
 Feeding on boll weevil, Bul. 25, pp. 9, 12, 20-21; Bul. 29, pp. 6, 19, 26, 30; Circ. 64, p. 5; fruit seeds, Bul. 15, pp. 74, 88; potato beetle, Bul. 32, p. 47; scale insects, Ybk. 1906, p. 192; weed seeds, Bul. 15, pp. 38-39; Ybk. 1898, p. 230.
 Food at Marshall Hall, Bul. 17, pp. 18, 21, 24, 25, 30, 31, 32, 34, 35, 38, 59, 60, 61, 62, 70, 71, 77, 98 (10 stomachs).
 Formal report, Bul. 32, pp. 5-27, 28, 90, 91 (498 stomachs).
Carpodacus mexicanus frontalis—House finch.
 Brief account, F. Bul. 54 (rev.), pp. 33-34 (987 stomachs); Ybk. 1900, pp. 302-303.
 Damaging fruit, Rept. 1900, p. 47; Rept. 1901, p. 153; peaches, Fauna 7, pp. 80, 81.
 Feeding on cherries, Bul. 34, p. 55; weed seeds, Bul. 34, p. 85.
 Food in California, Bul. 30, pp. 12, 13-23, 86 (1,206 stomachs).
 Injurious, Bul. 34, p. 8; Rept. 1900, p. 47; Rept. 1901, p. 153; Ybk. 1898, p. 107.
 Relation to fruit in California, Ybk. 1904, pp. 245, 246-248.
 Relation to orchards, Ybk. 1900, pp. 302-303.
Carpodacus purpureus—Purple finch.
 Brief account, Bul. 38, p. 61; Ybk. 1900, p. 302.
 Feeding on buds, Ybk. 1907, p. 173; climbing false buckwheat, Bul. 15, p. 42; mulberries, Rept. 1890, p. 285; ragweed, Bul. 15, p. 42.
 Food at Marshall Hall, Bul. 17, pp. 20, 62, 76-77, 97.
 Relation to orchards, Ybk. 1900, p. 302; Ybk. 1907, p. 173.
 Catarina, see *Psittacula insularis*.
 Catbird, see *Dumetella carolinensis*.
 Catharista atrata, see *Catharista urubu*.
Catharista urubu—Black buzzard.
 Brief account, Bul. 38, p. 36.
 Feeding on carrion, Bul. 2, p. 110; Rept. 1888, p. 524.
 Protected on account of, useful feeding habits, Bul. 12, p. 29; Bul. 12 (rev.), p. 32.
Cathartes aura septentrionalis—Turkey buzzard.
 Brief account, Bul. 38, p. 36.
 Feeding on carrion, Bul. 2, p. 110; Circ. 76, pp. 9-10; Fauna 7, pp. 33, 34; Fauna 25, p. 201; Rept. 1888, p. 524.
Cathartes aura septentrionalis—Continued.
 Food at Marshall Hall, Bul. 17, pp. 19, 53-54, 85.
 Food of young in captivity, Ybk. 1900, p. 431.
 Protected on account of useful feeding habits, Bul. 12, p. 29; Bul. 12 (rev.), p. 32.
Catherpes mexicanus punctulatus—Dotted cañon wren.
 Brief account, Bul. 30, pp. 65-66.
 Cedar bird, see *Bombycilla cedrorum*.
Centrocercus urophasianus—Sage hen.
 Brief account, Bul. 24, pp. 23-25.
 Flesh favored with sage, Fauna 5, p. 93.
Centurus aurifrons—Golden-fronted woodpecker.
 Brief account, Bul. 37, pp. 63, 64.
 Damage to poles, Bul. 39, p. 10.
Centurus carolinus—Red-bellied woodpecker.
 Brief account, Bul. 38, p. 48.
 Damage to buildings, Bul. 39, p. 13; poles, Bul. 39, p. 11.
 Formal report, Bul. 7, pp. 8, 10, 11, 23, 25-27 (22 stomachs); Bul. 37, pp. 10, 43, 47-52 (271 stomachs).
 Reference to vegetarian tastes, Bul. 34, p. 23.
 Relation to orchards, Ybk. 1900, p. 295.
Centurus uropygialis—Gila woodpecker.
 Brief account, Bul. 37, pp. 63, 64.
 Damage to poles, Bul. 39, pp. 10, 11.
Ceophloeus pileatus, see *Phloeotomus pileatus*.
Certhia familiaris americana—Brown creeper.
 Brief notes, Bul. 38, p. 88; Ybk. 1908, p. 346.
 Feeding on scale insects, Ybk. 1906, p. 197.
 Food at Marshall Hall, Bul. 17, pp. 32, 34, 35, 107.
 Relation to orchards, Ybk. 1900, pp. 296-297.
Certhia familiaris familiaris—Tree creeper.
 Feeding on scale insects, Ybk. 1906, p. 191.
Certhia familiaris occidentalis—California creeper.
 Feeding on codling moth, Bul. 34, pp. 17, 70.
 Food in California, Bul. 30, p. 66 (7 stomachs).
Ceryle alcyon—Belted kingfisher.
 Brief account, Bul. 38, p. 45; Ybk. 1900, p. 428.
 Feeding on eelpout (*Lota maculosa*), Fauna 27, p. 378.
 Food at Marshall Hall, Bul. 17, pp. 19, 53, 87-88 (5 stomachs).
 Food of nestlings, Ybk. 1900, pp. 411, 428.

Ceryle alcyon—Continued.

Injurious to fish, exempt from protection in certain States, Bul. 12, pp. 36, 37; Bul. 12 (rev.), p. 43.

Chæmpellia passerina terrestris—Ground dove.

Feeding on weed seeds, Ybk. 1898, p. 232.

Chætura pelagica—Chimney swift.

Feeding on mosquitoes, Bul. 38, p. 9; Rept. 1908, p. 577.

Food at Marshall Hall, Bul. 17, pp. 24, 25, 35, 39, 40, 91.

Insectivorous, Bul. 38, p. 9.

Chaffinch, see Fringilla cœlebs.

Chamæa fasciata—Wren tit.

Feeding on scale insects, Ybk. 1906, pp. 194, 195.

Food in California, Bul. 30, pp. 71-74 (165 stomachs).

Charadrius dominicus—Golden plover.

Feeding on crowberries (*Empetrum nigrum*), Fauna 27, pp. 332, 333; Ybk. 1903, p. 377; grasshoppers, Circ. 79, p. 2.

Feeds on caterpillars and cutworms, protected in Hawaii, Bul. 12 (rev.), p. 87.

Charitonetta albeola—Bufflehead.

Vegetable food, Circ. 81, p. 1.

Chat, yellow-breasted, see Icteria virens.

Chaulelasmus streperus—Gadwell.

Brief account, Bul. 38, p. 18.

Vegetable food, Circ. 81, p. 1.

Chelidon erythrogaster, see Hirundo erythrogastra.

Chelidon urbica, see Chelidonaria urbica.

Chelidonaria urbica—Old-world martin.

Value as insect destroyer, Bul. 1, pp. 330, 332, 333, 336, 346; Rept. 1886, p. 244.

Chen hyperboreus—Snow goose.

Feeding on club-rush, Fauna 7, p. 18; crowberries (*Empetrum nigrum*), Fauna 27, pp. 298, 301.

Chickadee, Black-capped, see Penthestes atricapillus.

Carolina, see Penthestes carolinensis.

Chestnut-backed, see Penthestes rufescens.

Mountain, see Penthestes gambeli.

Chloris chloris—Greenfinch.

Economic status, introduction dangerous, etc., Ybk. 1898, pp. 90, 106, 107, 109.

Feeding on caterpillars and corn, Bul. 1, p. 343.

Chondestes grammacus—Lark sparrow.

Brief account, Bul. 38, p. 63.

Feeding on boll weevil, Bul. 25, pp. 9, 12, 18, 21; Bul. 29, pp. 6, 19, 30; Circ. 64, p. 5; weed seeds, Ybk. 1898, pp. 226, 227, 228, 229.

Chondestes grammacus—Continued.

Formal report, Bul. 15, pp. 24, 27, 28, 45, 66-68, 91, 92 (167 stomachs).

Chordeiles acutipennis texensis—Texas nighthawk.

Feeding on *Ephydra hians*, Fauna 7, p. 53.

Chordeiles virginianus—Nighthawk.

Brief account, F. Bul. 54 (rev.), pp. 13-14 (about 100 stomachs).

Feeding on boll weevil, Bul. 25, pp. 8, 9, 13, 20, 21; Bul. 29, pp. 6, 21, 25, 30; Bul. 38, pp. 9, 51; Circ. 57, pp. 1, 4; Circ. 64, p. 5; Rept. 1906, p. 404; mosquitoes, Bul. 38, p. 9; Rept. 1908, p. 577; potato beetle, Bul. 32, p. 47.

Food at Marshall Hall, Bul. 17, pp. 19, 33, 91.

Useful, Ybk. 1904, p. 514.

Chuck-will's-widow, see Antrostomus carolinensis.

Ciconia ciconia—White stork.

Feeding on field mice, Bul. 31, p. 53.

Ciconia maguari, see Euxenura maguari.

Circus hudsonius—Marsh hawk.

Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670.

Brief account, Bul. 31, p. 43; Bul. 38, p. 37; Circ. 61, pp. 3, 6; Ybk. 1894, p. 217, 220; Ybk. 1900, pp. 301, 429.

Feeding on brown rat (probably), Bul. 33, p. 34; chipmunk (*Tamias minimus pictus*), Fauna 5, p. 94; cotton rat (*Sigmodon hispidus texianus*), Fauna 25, pp. 116, 117; field mice, Bul. 4, p. 15; Bul. 31, p. 43; Fauna 7, p. 35; Ybk. 1905, p. 371; horned larks, Bul. 23, p. 12; jack-rabbits, Bul. 8, p. 44; pocket gophers, Bul. 5, p. 20; rabbits, Bul. 4, p. 15; Ybk. 1907, p. 336; spermophiles, Bul. 4, pp. 15, 16, 17; (*Spermophilus townsendi*), shrew (*Neosorex*), Fauna 5, p. 94; squirrels, Bul. 4, p. 15.

Food at Marshall Hall, Bul. 17, pp. 54, 55, 86.

Food of nestlings, Ybk. 1900, p. 429.

Formal report, Bul. 3, pp. 11, 12, 26-32, 134 (124 stomachs); Rept. 1887, pp. 403-404 (46 stomachs); Rept. 1889, pp. 370-372.

Relation to orchards, Ybk. 1900, p. 301.

Cistothorus palustris, see Telmatodytes palustris.

Clangula clangula americana—Golden-eye.

Vegetable food, Circ. 81, p. 1.

Coccothraustes vespertina, see Hesperiphona vespertina.

Coccyzus americanus—Yellow-billed cuckoo.

Beneficial, Ybk. 1897, p. 670; Ybk. 1904, p. 514.

Coccyzus americanus—Continued.

Brief account, Bul. 1, p. 123; Bul. 38, p. 45; F. Bul. 54, pp. 5-6 (21 stomachs); F. Bul. 54 (rev.), pp. 7-8 (109 stomachs); Ybk. 1900, p. 297.

Feeding on caterpillars, Rept. 1889, p. 369; Rept. 1898, pp. 39-40; cotton worm, Bul. 25, pp. 19-20; mulberries, Rept. 1890, p. 285; potato beetle, Bul. 32, p. 47; Rept. 1889, p. 369; rose beetle, Bul. 32, p. 20; tussock moth, Bul. 1, pp. 108-109, 292, 324; Rept. 1886, p. 244; web-worms, Bul. 1, p. 123.

Food at Marshall Hall, Bul. 17, pp. 24, 29, 30, 87.

Formal report, Bul. 9, pp. 7-14 (109 stomachs).

Reference to studies of food habits, Ybk. 1899, p. 266.

Relation to orchards, Ybk. 1900, p. 297.

Coccyzus erythrophthalmus—Black-billed cuckoo.

Beneficial, Bul. 38, p. 45; Ybk. 1897, p. 670.

Brief account, F. Bul. 54, pp. 5-6 (16 stomachs); F. Bul. 54 (rev.), pp. 7-8 (46 stomachs); Ybk. 1900, pp. 297, 428.

Feeding on caterpillars, Rept. 1898, pp. 39-40; tussock moth, Bul. 1, pp. 108, 109; Rept. 1886, p. 244.

Food at Marshall Hall, Bul. 17, pp. 24, 87.

Food of nestlings, Ybk. 1900, p. 428.

Formal report, Bul. 9, pp. 7-14 (46 stomachs).

Reference to studies of food habits, Ybk. 1899, p. 266.

Relation to orchards, Ybk. 1900, p. 297.

Colaptes auratus—Flicker.

Beneficial, Ybk. 1897, p. 670; Ybk. 1904, p. 514.

Brief account, Bul. 12, p. 18; Bul. 12 (rev.), p. 25; Bul. 34, p. 25; Bul. 38, pp. 48-49; F. Bul. 54, pp. 7-8, 10; F. Bul. 54 (rev.), pp. 10-11, 13; Ybk. 1900, p. 294.

Damage to buildings, Bul. 39, pp. 13-14; poles, Bul. 39, p. 11; posts, Bul. 39, p. 13.

Distributing poison Rhus seeds, Rept. 1890, p. 283.

Feeding on ants, Fauna 27, p. 388.

Food at Marshall Hall, Bul. 17, pp. 19, 34, 38, 62, 90-91.

Food of nestlings, Ybk. 1900, p. 427.

Formal report, Bul. 7, pp. 8, 9, 10, 11, 16-20, 25, 38 (230 stomachs); Bul. 37, pp. 10, 12, 52-58, 59, 60, 61 (684 stomachs).

Relation to orchards, Ybk. 1900, p. 294.

Colaptes cafer collaris—Red-shafted flicker.

Brief account, F. Bul. 54, pp. 7-8; F. Bul. 54 (rev.), pp. 10-11.

Damage to buildings, Bul. 39, pp. 13-14; Fauna 7, p. 51; poles, Bul. 39, p. 11; posts, Bul. 39, pp. 13-14.

Feeding on juniper berries (probably), Fauna 16, p. 116.

Food in California, Bul. 34, pp. 25-28 (118 stomachs).

Formal report, Bul. 37, pp. 10, 59-62 (183 stomachs).

Colaptes chrysoides—Gilded flicker.

Brief account, Bul. 37, pp. 63, 64.

Colinus ridgwayi—Masked bobwhite.

Brief account, Bul. 21, pp. 46-47.

Colinus virginianus—Bobwhite.

Brief account, Bul. 38, pp. 9, 34; F. Bul. 54 (rev.), pp. 5-6; Ybk. 1900, p. 432; Ybk. 1909, p. 252.

Economic value, Bul. 38, p. 9; Rept. 1904, p. 294; Ybk. 1902, p. 206; Ybk. 1907, pp. 172, 594.

Feeding on boll weevil, Bul. 22, pp. 11-12, 16; Bul. 25, pp. 8, 13, 21; Bul. 29, pp. 6, 21, 30; Circ. 64, p. 5; garden pests, Circ. 81, p. 8; grain, Rept. 1898, p. 39; poison Rhus seeds, Rept. 1890, p. 283; potato beetle, Bul. 32, p. 47; seeds, Bul. 22, pp. 12, 13; weed seeds, Bul. 15, p. 37; Ybk. 1898, pp. 222, 231-232.

Food at Marshall Hall, Bul. 17, pp. 13, 22, 25, 26, 28, 32, 38, 40, 60, 62, 69-70, 71, 78, 83-85, 110, 111 (13 stomachs).

Food of nestlings, Ybk. 1900, p. 432.

Formal report, Bul. 21, pp. 9-46 (918 stomachs); Ybk. 1903, pp. 193-204 (801 stomachs).

Natural and valuable cultivated foods, Ybk. 1909, p. 194.

Columba fasciata—Band-tailed pigeon.

Feeding on acorns and berries of *Arbutus menziesii*, Fauna 7, p. 31.

Columba flavirostris madrensis—Tres Marias pigeon.

Feeding on figs and guavas, Fauna 14, p. 35.

Columba livia—Common pigeon.

Feeding on army worms, Bul. 1, pp. 290-291.

Columba palumbus—Wood pigeon.

Injurious in England, Bul. 1, p. 335.

Colymbus auritus—Horned grebe.

Food at Marshall Hall, Bul. 17, p. 79.

Compsothlypis americana—Parula warbler.

Brief account, Bul. 38, p. 77.

Food at Marshall Hall, Bul. 17, pp. 23, 24, 103-104.

Condor, California, see *Gymnogyps californianus*.

Contopus richardsoni, see *Myiochanes richardsoni*.

Contopus virens, see *Myiochanes virens*.

- Conuropsis carolinensis*—Carolina parakeet.
Brief account, Bul. 38, p. 44.
- Coot, see *Fulica americana*.
- Cormorant, Double-crested, see *Phalacrocorax auritus*.
- Cormorant, Red-faced, see *Phalacrocorax urile*.
- Corvus americanus*, see *Corvus brachyrhynchos*.
- Corvus brachyrhynchos*—American crow.
Bounty laws, Ybk. 1896, pp. 55, 57, 58, 59, 61; Ybk. 1899, pp. 279, 280, 281, 282.
Brief account, Bul. 31, pp. 50-51; Bul. 38, p. 56; F. Bul. 54, pp. 3, 15-17; F. Bul. 54 (rev.), pp. 3, 22-23, 25; Ybk. 1897, pp. 345, 346-348; Ybk. 1900, p. 424; Ybk. 1907, pp. 170, 175, 177, 178.
Damage to grain, Bul. 12, pp. 36, 37; Bul. 12 (rev.), p. 43; Rept. 1898, p. 39; Ybk. 1897, pp. 345, 346-348.
Distributing poison *Rhus*, Rept. 1889, p. 368; and other seeds, Rept. 1890, pp. 282-284.
Equally beneficial and injurious, Bul. 12, p. 49; Bul. 12 (rev.), p. 58.
Feeding on corn, Bul. 3, p. 9; Bul. 32, p. 91; Rept. 1886, p. 242; cutworms, Bul. 3, p. 9; eggs and young of bobwhite, Bul. 21, p. 22; of ruffed grouse, Bul. 24, p. 28; of shorebirds, Circ. 79, p. 2; field mice, Bul. 31, pp. 50-51; Ybk. 1905, p. 371; (*Microtus montanus*) F. Bul. 335, p. 12; F. Bul. 352, p. 21; Ybk. 1908, p. 309; figs, Fauna 7, p. 72; insects, Ybk. 1908, p. 347; poison *Rhus* seeds, Bul. 24, p. 36; poisoned wheat, F. Bul. 352, p. 8; potato beetle, Bul. 32, p. 47.
Food at Marshall Hall, Bul. 17, pp. 13-14, 23, 24, 28, 30, 32, 34, 35, 37, 38, 43, 47-48, 50, 53, 54, 55, 56, 57-58, 59, 60, 61, 62, 63-64, 65-66, 68, 84, 94, 110.
Food of nestlings, Ybk. 1900, pp. 424-425, 436.
Formal report, Bul. 6, pp. 1-98 (909 stomachs); Rept. 1888, pp. 498-534 (86 stomachs).
Injurious, hence unprotected in certain States, Bul. 12, pp. 36, 37; Bul. 12 (rev.), p. 43; Bul. 38, p. 10.
Other notes, Rept. 1890, p. 279.
Predatory, F. Bul. 390, p. 23.
Reference to studies of food, Ybk. 1899, pp. 265, 266.
Request for information on economic relations, Ent. Circ. 20 [p. 1]; Circ. 1 [p. 2]; Rept. 1886, p. 230.
Scalps paid in lieu of taxes, Ybk. 1896, p. 67.
- Corvus caurinus*—Northwestern crow.
Feeding on field mice, Bul. 31, p. 50; pheasant eggs, Rept. 1888, p. 485.
- Corvus corax corax*—Old-world raven.
Feeding on lemmings and voles, Bul. 31, p. 50.
- Corvus corax principalis*—Northern raven.
Feeding on carrion, Fauna 24, p. 71; Fauna 30, pp. 40, 62, 90; crabs, Fauna 21, p. 47.
- Corvus corax sinuatus*—Southern raven.
Feeding on carrion, Fauna 7, p. 71; field mice, Bul. 31, p. 50; (*Microtus montanus*) F. Bul. 335, p. 12; F. Bul. 352, p. 21; Rept. 1908, p. 573; Ybk. 1908, p. 309; grasshoppers, Fauna 7, pp. 38, 71.
- Corvus corone*—Carrion crow.
Feeding on eggs and young of *Perdix perdix*, Bul. 6, p. 41; lemmings and voles, Bul. 31, p. 50.
- Corvus cryptoleucus*—White-necked raven.
Feeding on field mice, Bul. 31, p. 50; pocket gophers (probably), Bul. 6, p. 35.
- Corvus frugilegus*—Rook.
Feeding on lemmings and voles, Bul. 31, p. 50.
- Corvus ossifragus*—Fish crow.
Brief account, Rept. 1888, pp. 498, 500, 515, 525, 534-535 (12 stomachs).
Feeding on cultivated fruit, Bul. 6, p. 82; field mice, Bul. 31, p. 50; sumach seeds, Rept. 1890, pp. 283-284.
Food at Marshall Hall, Bul. 17, pp. 14, 63.
- Coturniculus savannarum passerinus*, see *Ammodramus savannarum australis*.
- Cowbird, see *Molothrus ater*.
- Crane, Little brown, see *Grus canadensis*.
- Sandhill, see *Grus mexicana*.
- Whooping, see *Grus americana*.
- Creeper, Black-and-white, see *Mniotilta varia*.
Brown, see *Certhia familiaris americana*.
California, see *Certhia familiaris occidentalis*.
Tree, see *Certhia familiaris familiaris*.
- Crossbill, see *Loxia curvirostra minor*.
White-winged, see *Loxia leucopetra*.
- Crow, American, see *Corvus brachyrhynchos*.
Carrion, see *Corvus corone*.
Clarke's, see *Nucifraga columbiana*.
Fish, see *Corvus ossifragus*.
Northwestern, see *Corvus caurinus*.
- Cryptoglaux acadica*—Saw-whet owl.
Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.
Feeding on field mice, Bul. 31, p. 50; Ybk. 1905, p. 371.
Formal report, Bul. 3, pp. 11, 160-162 (22 stomachs); Rept. 1887, p. 419 (6 stomachs).

Cryptoglaux funerea richardsoni—Richardson's owl.

Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 3, pp. 11, 159.

Feeding on field mice (*Microtus drummondii*), red-back mice (*Erotomys gapperi athabascæ*), and white-footed mice (*Peromyscus arcticus*), Fauna 27, p. 370.

Cuckoo, Black-billed, see *Coccyzus erythrophthalmus*.

Yellow-billed, see *Coccyzus americanus*.

Curlew, Hudsonian, see *Numenius hudsonicus*.

Long-billed, see *Numenius americanus*.

Cyanistes cæruleus—Blue titmouse.

Admission denied, Ybk. 1905, p. 545.

Economic status in view of proposed introduction, Rept. 1899, p. 67.

Feeding on scale insects, Ybk. 1906, pp. 191, 192.

Cyanocephalus cyanocephalus—Piñon jay.

Feeding on piñon nuts, Fauna 3, pp. 39, 94; (*Pinus monophylla*) Fauna 7, pp. 73, 337.

Cyanocitta cristata—Blue jay.

Brief account, Bul. 38, p. 55; F. Bul. 54, pp. 14–15 (292 stomachs); F. Bul. 54 (rev.), pp. 18–19 (300 stomachs); Ybk. 1907, pp. 171–172.

Feeding on boll weevil, Circ. 64, p. 5; brown-tall moth, Ybk. 1907, pp. 171–172; eggs and young of smaller birds, Rept. 1888, p. 514; English sparrow, Bul. 1, pp. 31, 32, 233, 234; mahaleb cherry, Bul. 32, p. 65; scale insects, Ybk. 1906, p. 197.

Food at Marshall Hall, Bul. 17, pp. 20, 24, 29, 32, 35, 38, 40, 60, 93–94 (6 stomachs).

Formal report, Ybk. 1896, pp. 197–206 (292 stomachs).

Predatory, Bul. 1, p. 268; Bul. 34, p. 47.

Reference to studies of food habits, Ybk. 1899, p. 265.

Cyanocitta stelleri—Steller's jay.

Brief account, F. Bul. 54 (rev.), pp. 19–20.

Feeding on piñon nuts, Fauna 3, pp. 39, 94.

Food in California, Bul. 34, pp. 8, 47–49 (93 stomachs).

Cyanospiza ciris, see *Passerina ciris*.**Cyanospiza cyanea**, see *Passerina cyanea*.**Cyclorhynchus psittaculus**, see *Phaleris psittacula*.**Cyrtonyx montezumæ mearnsi**—Mearns's quail.

Formal report, Bul. 21, pp. 63–64 (9 stomachs).

D.

Dafila acuta—Pintail.

Brief account, Bul. 38, p. 20.

Feeding on *Lymnæa palustris*, Fauna 27, p. 283.

Vegetable food, Circ. 81, p. 1.

Dendragapus obscurus—Dusky grouse.

Feeding on ants, Fauna 16, p. 110; bearberries (*Arctostaphylos uva-ursi*), Fauna 5, p. 93; Fauna 27, p. 337; currants (*Ribes cereum*), grasshoppers and other insects, leaves of willow, Fauna 5, p. 93; (*Salix myrtillifolia*) Fauna 27, p. 337; manzanita berries (*Arctostaphylos nevadensis*), Fauna 16, p. 110; mountain cranberries (*Vitis-idaea vitis-idaea*), Fauna 27, p. 337; seeds of *Pentstemon gracilentus*, Fauna 16, p. 110.

Formal report, Bul. 24, pp. 41–44 (45 stomachs).

Dendroica æstiva—Yellow warbler.

Brief account, Bul. 38, p. 77.

Feeding on boll weevil, Bul. 29, pp. 6, 21, 25, 30; Circ. 64, p. 5; mulberries, Rept. 1890, p. 285; scale insects, Ybk. 1906, p. 194.

Food at Marshall Hall, Bul. 17, pp. 20, 23, 24, 25, 30, 33, 34, 35, 39, 40, 103–104 (7 stomachs).

Food in California, Bul. 30, pp. 47–49 (98 stomachs).

Dendroica auduboni—Audubon's warbler.

Feeding on insects (in cabbage), Fauna 7, p. 119; (noxious) Ybk. 1904, p. 254; scale insects, Ybk. 1906, pp. 194, 195.

Food in California, Bul. 30, pp. 43–46 (383 stomachs).

Dendroica cærulescens—Black-throated blue warbler.

Food at Marshall Hall, Bul. 17, p. 20.

Dendroica castanea—Bay-breasted warbler.

Feeding on mulberries, Rept. 1890, p. 285.

Dendroica coronata—Myrtle warbler.

Brief account, Bul. 38, p. 78.

Distributing poison *Rhus* seeds, Rept. 1890, p. 283.

Feeding on boll weevil, Circ. 64, p. 5; scale insects, Ybk. 1906, pp. 194, 195; seeds, Rept. 1890, p. 282.

Food at Marshall Hall, Bul. 17, pp. 20, 62, 103–104.

Food in California, Bul. 30, p. 46 (10 stomachs).

Dendroica discolor—Prairie warbler.

Food at Marshall Hall, Bul. 17, pp. 20, 34, 103–104.

Dendroica maculosa, see *Dendroica magnolia*.**Dendroica magnolia**—Magnolia warbler.

Feeding on scale insects, Ybk. 1906, p. 195.

- Dendroica magnolia*—Continued.
Food at Marshall Hall, Bul. 17, pp. 20, 29, 34, 35, 40, 103-104.
- Dendroica palmarum*—Palm warbler.
Number of insects eaten per minute, Bul. 17, p. 104.
- Dendroica striata*—Black-poll warbler.
Feeding on scale insects, Ybk. 1906, p. 195.
Food at Marshall Hall, Bul. 17, pp. 20, 23, 24, 29, 34, 35, 39, 40, 103-104 (11 stomachs).
- Dendroica tigrina*—Cape May warbler.
Feeding on mulberries, Rept. 1890, p. 285.
- Dendroica townsendi*—Townsend's warbler.
Feeding on scale insects, Ybk. 1906, p. 197.
Food in California, Bul. 30, pp. 46-47 (31 stomachs).
- Dendroica vigosii*—Pine warbler.
Brief account, Bul. 38, p. 80.
Food at Marshall Hall, Bul. 17, p. 20.
- Dendroica virens*—Black-throated green warbler.
Food at Marshall Hall, Bul. 17, p. 20.
- Dickcissel, see *Spiza americana*.
- Dolichonyx oryzivorus*—Bobolink.
Bounty laws, Ybk. 1896, p. 57; Ybk. 1899, p. 279.
Brief account, Bul. 38, pp. 56-57; F. Bul. 54, pp. 4, 17-19; F. Bul. 54 (rev.), pp. 4, 23-24; Rept. 1886, pp. 246-250; Ybk. 1907, p. 171.
Damage to grain, Bul. 1, p. 70; Bul. 12, pp. 35, 36; Bul. 12 (rev.), p. 42; Bul. 32, p. 80; Rept. 1887, pp. 428, 431; Ybk. 1898, pp. 230, 232; rice, Bul. 1, p. 76; Bul. 3, p. 9; Bul. 12, p. 18; Bul. 12 (rev.), p. 25-26; Bul. 15, p. 17; Bul. 30, p. 12; Ent. Circ. 20 [p. 2]; Circ. 1 [p. 2]; Circ. 5 [p. 1]; Rept. 1886, pp. 229, 234, 235, 246-250; Rept. 1900, p. 44; Ybk. 1903, p. 375; Ybk. 1904, pp. 245, 253.
Feeding on weed seeds, Ybk. 1898, pp. 230, 232; wild rice, Bul. 1, p. 76; Bul. 3, p. 9; Bul. 12, p. 18.
Food at Marshall Hall, Bul. 17, pp. 24, 30, 34, 35, 40, 71, 95 (6 stomachs).
Formal report, Bul. 13, pp. 8, 9, 11, 12-22 (291 stomachs).
Injurious, hence exempt from protection in certain States, Bul. 12, p. 36; Bul. 12 (rev.), p. 43.
Insectivorous, Bul. 12, pp. 14, 24; Bul. 12 (rev.), pp. 22, 31.
Other notes, Rept. 1887, pp. 400-401; Rept. 1890, p. 279; Ybk. 1904, pp. 245, 253.
Request for information on economic relations, Ent. Circ. 20 [p. 2]; Circ. 1 [p. 2]; Circ. 5 [p. 1]; Rept. 1886, pp. 230, 234.
- Dove, Ground, see *Chæmepelia passerina terrestris*.
Mourning, see *Zenaidura macroura carolinensis*.
Ring, see *Columba palumbus*.
Rock, see *Columba livia*.
- Dowitcher, see *Macrorhamphus griseus*.
- Dryobates arizonæ*—Arizona woodpecker.
Relation to orchards, Ybk. 1900, p. 295.
- Dryobates borealis*—Red-cockaded woodpecker.
Feeding on scale insects, Ybk. 1906, p. 197.
Formal report, Bul. 37, pp. 10, 22-23 (76 stomachs).
Relation to orchards, Ybk. 1900, p. 295.
- Dryobates nuttalli*—Nuttall's woodpecker.
Feeding on scale insects, Ybk. 1906, p. 194.
Food in California, Bul. 34, pp. 19-21 (46 stomachs).
Formal report, Bul. 37, pp. 10, 23-25 (53 stomachs).
Relation to orchards, Ybk. 1900, p. 295.
- Dryobates pubescens*—Downy woodpecker.
Beneficial, Ybk. 1897, p. 670.
Brief account, Bul. 34, p. 17; Bul. 38, p. 46; F. Bul. 54, pp. 6-7, 9; F. Bul. 54 (rev.), pp. 9-10, 13; Ybk. 1900, pp. 292-293, 295, 427.
Damage to posts, Bul. 39, p. 13.
Distributing poison *Rhus* seeds, Rept. 1890, p. 283.
Feeding on mulberries, Rept. 1890, p. 285; scale insects, Ybk. 1906, pp. 194, 197.
Food at Marshall Hall, Bul. 17, pp. 19, 24, 33, 34, 35, 38, 40, 47, 59, 60, 61, 62, 76, 88 (13 stomachs).
Food in California, Bul. 34, pp. 17-19, 20 (80 stomachs).
Food of nestlings, Ybk. 1900, p. 427.
Formal report, Bul. 7, pp. 8, 9, 10, 11-14, 15, 16, 18, 38 (140 stomachs); Bul. 37, pp. 10, 11, 12, 17-22, 24 (723 stomachs).
Relation to orchards, Ybk. 1900, pp. 292-293, 295.
Tapping trees, Bul. 39, pp. 92-95.
- Dryobates scalaris bairdi*—Texas woodpecker.
Brief account, Bul. 37, p. 63.
Damage to poles, Bul. 39, pp. 10, 11; posts, Bul. 39, p. 13.
Relation to orchards, Ybk. 1900, p. 295.
- Dryobates scalaris graysoni*—Grayson's woodpecker.
Feeding habits, Fauna 14, p. 43.
- Dryobates scalaris lucasanus*—San Lucas woodpecker.
Damage to poles, Bul. 39, p. 11.
Relation to orchards, Ybk. 1900, p. 295.
- Dryobates villosus*—Hairy woodpecker.
Beneficial, Bul. 38, p. 46; Ybk. 1897, p. 670.

Dryobates villosus—Continued.

- Brief account, Bul. 34, p. 16; F. Bul. 54, pp. 6-7, 9; F. Bul. 54 (rev.), pp. 9-10, 13; Ybk. 1900, pp. 292, 293-294.
 Damage to posts, Bul. 39, p. 13.
 Distributing poison *Rhus* seeds, Rept. 1890, p. 283.
 Feeding on scale insects, Ybk. 1906, p. 197.
 Food in California, Bul. 34, pp. 15-17, 20, 22 (27 stomachs).
 Formal report, Bul. 7, pp. 8, 9, 10, 11, 14-16, 18, 38 (82 stomachs); Bul. 37, pp. 10, 11, 12, 13-17 (382 stomachs).
 Relation to orchards, Ybk. 1900, pp. 292, 293-294.
 Tapping trees, Bul. 39, pp. 92-95.
- Duck, Black, see *Anas rubripes*.
 Greater scaup, see *Marila marila*.
 Lesser scaup, see *Marila affinis*.
 Mallard, see *Anas platyrhynchos*.
 Pintail, see *Dasila acuta*.
 Ring-necked, see *Marila collaris*.
 Ruddy, see *Erismatura jamaicensis*.
 Spoonbill, see *Spatula clypeata*.
 Wood, see *Aix sponsa*.

Dumetella carolinensis—Catbird.

- Beneficial, Bul. 38, p. 9.
 Brief account, Bul. 38, p. 85; F. Bul. 54, pp. 33-34; F. Bul. 54 (rev.), pp. 39-40 (213 stomachs); Ybk. 1900, pp. 303-304, 416.
 Feeding on fruit, Rept. 1890, p. 281; Ybk. 1907, p. 169; mahaleb cherries (*Prunus mahaleb*), Bul. 32, p. 65; mulberries, Bul. 32, pp. 64, 65; Rept. 1890, p. 285.
 Food at Marshall Hall, Bul. 17, pp. 17-18, 21, 23, 24, 25, 26, 28, 29, 30, 32, 33, 34, 35, 36, 37, 38, 39, 40, 43, 47, 55-56, 57, 58, 59, 60, 61, 62, 104-105 (74 stomachs).
 Food of nestlings, Ybk. 1900, pp. 416, 436.
 Formal report, Ybk. 1895, pp. 405, 406-411, 414, 418 (213 stomachs).
 Other notes, Bul. 1, pp. 126, 304; Bul. 15, p. 29.
 Reference to studies of food habits, Ybk. 1899, p. 266.
 Relation to orchards, Ybk. 1900, pp. 303-304.
 Request for information on economic relations, Ent. Circ. 20 [p. 2].

E.

- Eagle, Bald, see *Haliaeetus leucocephalus*.
 Golden, see *Aquila chrysaetos*.
 Gray sea, see *Haliaeetus albicilla*.
Ectopistes migratorius—Passenger pigeon.
 Damage to grain, Fauna 27, p. 351.
 Food of adults and nestlings, Ybk. 1900, p. 431.

Egret, see *Herodias egretta*.

- Snowy, see *Egretta candidissima*.
Egretta candidissima—Snowy egret.
 Brief account, Ybk. 1900, p. 435.
 Feeding on field mice, Bul. 31, p. 52.
Elanoides forficatus—Swallow-tailed kite.
 Beneficial, Bul. 31, p. 45; Ybk. 1895, p. 590; Ybk. 1896, p. 628.
 Brief account, Bul. 38, p. 37; Circ. 61, pp. 3, 4; Ybk. 1894, pp. 217, 218.
 Formal report, Bul. 3, pp. 11, 20-22, 23, 24 (6 stomachs); Rept. 1887, p. 403 (5 stomachs).
Elanus leucurus—White-tailed kite.
 Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628.
 Brief account, Bul. 3, pp. 11, 23; Circ. 61, pp. 3, 4; Ybk. 1894, pp. 217, 218.
 Feeding on lizards and snakes, Bul. 2, p. 113.
Emberiza citrinella—Old-world yellow-hammer.
 Injurious in New Zealand, Ybk. 1909, p. 257.
Empidonax difficilis—Western yellow-bellied flycatcher.
 Food in California, Bul. 34, pp. 41-44 (141 stomachs).
Empidonax minimus—Least flycatcher.
 Feeding on boll weevil, Bul. 25, pp. 8, 13, 17, 19, 20, 21; Bul. 29, pp. 6, 14-15, 24, 30; Circ. 64, p. 5; mulberries, Bul. 32, p. 64; Rept. 1890, p. 285.
Empidonax traillii—Traill's flycatcher.
 Brief account, Bul. 34, p. 44.
 Feeding on boll weevil, Bul. 29, pp. 6, 15, 24, 30; Circ. 64, p. 5.
Empidonax virescens—Acadian flycatcher.
 Brief account, Bul. 38, p. 54.
 Feeding on rose beetle, Bul. 32, p. 20.
 Food at Marshall Hall, Bul. 17, pp. 36, 92.
Ereunetes pusillus—Peep.
 Feeding on mosquitoes, Circ. 79, p. 2.
Erismatura jamaicensis—Ruddy duck.
 Vegetable food, Circ. 81, p. 1.
Euphagus carolinus—Rusty blackbird.
 Brief account, Bul. 38, p. 59; Ybk. 1897, pp. 351-352.
 Damage to grain, Rept. 1887, p. 428; Ybk. 1897, pp. 351-352; Ybk. 1898, p. 230.
 Feeding on boll weevil, Circ. 64, pp. 3, 5; weed seeds, Ybk. 1898, p. 230.
 Food at Marshall Hall, Bul. 17, pp. 14, 35, 38, 39, 71, 77, 96.
 Formal report, Bul. 13, pp. 9, 45-49 (132 stomachs).
Euphagus cyanocephalus—Brewer's blackbird.
 Brief account, Ybk. 1897, pp. 351-352.
 Damage to fruit, Bul. 30, p. 13; Ybk. 1904, pp. 246, 248; grain, Bul. 23,

Euphagus cyanocephalus—Continued.

p. 15; Bul. 29, p. 8; Fauna 27, p. 412; Rept. 1887, p. 430; Ybk. 1897, pp. 351-352; Ybk. 1898, p. 230.

Feeding on boll weevil, Bul. 22, p. 16; Bul. 25, pp. 9, 10, 11-12, 21; Bul. 29, pp. 6, 7, 8, 11, 17, 27, 28, 30; Circ. 64, pp. 3, 5; cankerworms, Ybk. 1908, p. 345; corn, Bul. 29, p. 8; crumbs in streets and door-yards, Fauna 5, p. 101; grasshoppers, Fauna 7, p. 78; weed seeds, Ybk. 1898, p. 230; wheat, Bul. 23, p. 15.

Food in California, Bul. 34, pp. 59-65 (312 stomachs).

Formal report, Bul. 13, pp. 9, 10, 11, 50-52 (146 stomachs).

Relation to fruit in California, Bul. 30, p. 13; Ybk. 1904, pp. 246, 248.

Euxenura maguari—Maguari stork.

Feeding on mice, Bul. 31, pp. 52-53.

F.

Falco columbarius—Pigeon hawk.

Brief account, Bul. 31, p. 45; Bul. 38, p. 40; Circ. 61, pp. 3, 13, 14; Ybk. 1894, pp. 217, 227, 228.

Equally beneficial and injurious, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Feeding on crossbills, Fauna 21, p. 76; English sparrow, Bul. 1, pp. 32, 309; field mice, Bul. 31, p. 45; Fauna 19, p. 75; Ybk. 1905, p. 371; red-backed mouse, Fauna 19, p. 75; ruby-crowned kinglet, Fauna 30, p. 38; sparrow, Fauna 27, p. 363; tree sparrow, Fauna 27, p. 364.

Formal report, Bul. 3, pp. 15, 109-113, 114, 115 (60 stomachs); Rept. 1887, pp. 402, 414 (19 stomachs).

Injurious, Bul. 12, p. 30; Bul. 12 (rev.), p. 33.

Falco fusco-cærulescens—Aplomado falcon.

Brief account, Bul. 3, pp. 15, 114-115; Circ. 61, pp. 3, 13, 14; Ybk. 1894, pp. 217, 227, 228.

Equally beneficial and injurious. Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Falco islandus—White gyrfalcon.

Brief account, Bul. 3, pp. 15, 16, 102; Circ. 61, pp. 3, 16; Ybk. 1894, pp. 218, 230.

Injurious, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Falco mexicanus—Prairie falcon.

Brief account, Bul. 31, p. 45; Circ. 61, pp. 3, 13, 14-15; Rept. 1887, p. 414; Ybk. 1894, pp. 217, 227, 228-229.

Equally beneficial and injurious, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Feeding on chicken (chasing), Fauna 5, p. 95; doves (chasing), Fauna 7, p. 40; ducks, Gambel's quail (watch-

Falco mexicanus—Continued.

ing), Fauna 7, p. 39; horned larks, Bul. 23, p. 12; Fauna 5, p. 95; jack rabbits, Bul. 8, p. 44; spermophiles, Bul. 4, pp. 16-17.

Formal report, Bul. 3, pp. 15, 104-106 (11 stomachs).

Falco peregrinus—Duck hawk.

Brief account, Bul. 31, p. 44; Bul. 38, pp. 10, 40; Circ. 61, pp. 3, 16-17; Ybk. 1894, pp. 218, 230-231.

Feeding on Alaska jays, intermediate sparrows, Fauna 19, p. 75; mallard (chasing), Fauna 27, p. 362; marsh hawks, Fauna 19, p. 75; scaup duck (chasing), Fauna 30, p. 88; sparrow hawk (chasing), Fauna 14, p. 38; varied thrushes, Fauna 19, p. 75; white-winged crossbills, Fauna 19, pp. 75, 82.

Formal report, Bul. 3, pp. 15, 16, 106-109, 184 (20 stomachs); Rept. 1887, pp. 402, 414 (5 stomachs).

Injurious, Bul. 12, p. 30; Bul. 12 (rev.), p. 33; Bul. 38, p. 10; Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670; Ybk. 1908, p. 192.

Falco richardsoni, see *Falco columbarius*.*Falco rusticolus*—Gray gyrfalcon.

Brief account, Bul. 3, pp. 15, 16, 102-103; Circ. 61, pp. 3, 16; Ybk. 1894, pp. 218, 230.

Feeding on bird, Fauna 19, p. 74; ptarmigan (apparently chasing), Fauna 27, p. 361.

Injurious, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Falco sparverius—Sparrow hawk.

Beneficial, Bul. 12, p. 30; Bul. 12 (rev.), p. 33; Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670.

Brief account, Bul. 12, p. 30; Bul. 12 (rev.), p. 33; Bul. 31, p. 45; Bul. 38, p. 41; Circ. 61, pp. 3, 9-10; Ybk. 1894, pp. 217, 223; Ybk. 1900, p. 430.

Feeding on cotton rat (*Sigmodon hispidus texianus*), Fauna 25, p. 116; English sparrow, Bul. 1, pp. 32, 150, 234, 309; Rept. 1886, p. 245; field mice, Bul. 31, p. 45; Ybk. 1905, p. 371; (*Microtus drummondi*) Fauna 27, p. 365; grasshoppers, Bul. 12, p. 30; Bul. 12 (rev.), p. 33; Fauna 3, p. 39; Fauna 5, p. 95; Fauna 7, p. 41; Fauna 16, p. 113; Ybk. 1907, p. 166; insects, Fauna 3, p. 91; red-backed mouse (*Evotomys dawsoni*), Fauna 27, p. 365; snake, Fauna 7, p. 41.

Food at Marshall Hall, Bul. 17, pp. 19, 86.

Food of nestlings, Ybk. 1900, p. 430.

Falco sparverius—Continued.

Formal report, Bul. 3, pp. 11, 13, 115-127, 192 (320 stomachs); Rept. 1887, pp. 414-417 (133 stomachs); Rept. 1888, pp. 491-496 (163 stomachs).

Other notes, Bul. 1, p. 150; Bul. 9, p. 16; Bul. 30, pp. 33-34; Rept. 1886, p. 245.

Falcon, Aplomado, see *Falco fusco-cærulescens*.

Prairie, see *Falco mexicanus*.

Finch, Gray-crowned rosy, see *Leucosticte tephrocotis*.

House, see *Carpodacus mexicanus frontalis*.

Purple, see *Carpodacus purpureus*.

Flicker, see *Colaptes auratus*.

Gilded, see *Colaptes chrysoides*.

Red-shafted, see *Colaptes cafer collaris*.

Florida *cærulea*—Little blue heron.

Brief account, Bul. 38, p. 26; Ybk 1900, p. 435.

Food at Marshall Hall, Bul. 17, pp. 19, 81.

Flycatcher, Acadian, see *Empidonax virens*.

Ash-throated, see *Myiarchus cinerascens*.

Crested, see *Myiarchus crinitus*.

Least, see *Empidonax minimus*.

Olive-sided, see *Nuttallornis borealis*.

Scissor-tailed, see *Muscivora forficata*.

Traill's, see *Empidonax trailli*.

Western yellow-bellied, see *Empidonax difficilis*.

Foudia madagascariensis — Madagascar weaver bird.

Injurious wherever introduced, Rept. 1904, p. 296.

Fratercula corniculata—Horned puffin.

Food of nestlings, Ybk. 1900, p. 433.

Fringilla cœlebs—Chaffinch.

Feeding on caterpillars, corn, Bul. 1, p. 343; seeds, Bul. 1, p. 335.

Injurious in New Zealand, Ybk. 1909, p. 257.

Fulica americana—Coot.

Brief account, Bul. 38, pp. 18, 28-29.

Food at Marshall Hall, Bul. 17, pp. 81-82.

G.

Gadwell, see *Chaulelasmus streperus*.

Galeoscoptes carolinensis, see *Dumetella carolinensis*.

Gallinago delicata—Jacksnipe.

Feeding on click beetles, crane flies, crayfish, Circ. 79, p. 6; Dytiscidæ, Circ. 79, p. 8; grasshoppers, Circ. 79, p. 4; wireworms, Circ. 79, p. 6.

Garrulus glandarius—Old-world jay.

Food of nestlings, Ybk. 1900, p. 411.

Gavia arctica—Black-throated loon.

Food of nestlings, Ybk. 1900, p. 433.

Gavia stellata—Red-throated loon.

Feeding on fishes, Fauna 27, p. 259.

Geococcyx californianus—Road runner.

Feeding on field mice, Bul. 31, p. 51.

Geothlypis trichas—Yellowthroat.

Brief account, Bul. 38, p. 82.

Feeding on boll weevil, Circ. 64, p. 5; scale insects, Ybk. 1906, p. 194.

Food at Marshall Hall, Bul. 17, pp. 20, 22, 24, 28, 30, 32, 34, 35, 38, 39, 40, 103-104 (13 stomachs).

Food in California, Bul. 30, pp. 49-50 (114 stomachs).

Insectivorous, Ybk. 1908, p. 344.

Glaucidium gnoma—Pygmy owl.

Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Feeding on spermophiles, Bul. 4, p. 16.

Food of nestlings, Ybk. 1900, p. 431.

Formal report, Bul. 3, pp. 11, 196-198 (6 stomachs).

Glaucidium phalœnoides—Ferruginous pygmy owl.

Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 3, pp. 11, 199.

Glaux funerea richardsoni, see *Cryptoglaux funerea richardsoni*.

Gnatcatcher, Black-tailed, see *Poliophtila californica*.

Blue-gray, see *Poliophtila cærulea*.

Godwit, Hudsonian, see *Limosa hæmastica*.

Marbled, see *Limosa fedoa*.

Golden-eye, see *Clangula clangula americana*.

Goldfinch, see *Astragalinus tristis*.

Green-backed, see *Astragalinus psaltria hesperophilus*.

Goose, Canada, see *Branta canadensis*.

Snow, see *Chen hyperboreus*.

Goshawk, see *Astur atricapillus*.

Mexican, see *Asturina plagiata*.

Grackle, Purple, see *Quiscalus quiscula*.

Grebe, Horned, see *Colymbus auritus*.

Pied-billed, see *Podilymbus podiceps*.

Greenfinch, see *Chloris chloris*.

Grosbeak, Alaska pine, see *Pinicola enucleator alascensis*.

Black-headed, see *Zamelodia melanocephala*.

Blue, see *Guiraca cærulea*.

Evening, see *Hesperiphona vespertina*.

Gray, see *Pyrrhuloxia sinuata*.

Pine, see *Pinicola enucleator leucura*.

Rose-breasted, see *Zamelodia ludoviciana*.

- Grouse, Dusky, see *Dendragapus obscurus*.
 Franklin's, see *Canachites franklini*.
 Ruffed, see *Bonasa umbellus*.
 Sharp-tailed, see *Pediæcetes phasianellus*.
 Spruce, see *Canachites canadensis*.
 Wood, see *Tetrao urogallus*.
- Grus americana*—Whooping crane.
 Feeding on field mice, Bul. 31, p. 53.
- Grus canadensis*—Little brown crane.
 Feeding on barley, Fauna 7, pp. 20-21;
 field mice, Bul. 31, p. 53; foliage
 and rootlets, Fauna 7, pp. 20-21.
- Grus mexicana*—Sandhill crane.
 Feeding on field mice, Bul. 31, p. 53.
 Food of young in captivity, Ybk. 1900,
 p. 433.
- Guiraca caerulea*—Blue grosbeak.
 Brief account, F. Bul. 456, pp. 11-12.
 Feeding on weed seeds, Ybk. 1898, p.
 230.
 Formal report, Bul. 32, pp. 78-85, 87,
 91 (51 stomachs).
- Guiraca ludoviciana*, see *Zamelodia ludoviciana*.
- Gull, California, see *Larus californicus*.
 Franklin's, see *Larus franklini*.
 Glaucous-winged, see *Larus glaucescens*.
 Great black-backed, see *Larus marinus*.
 Heermann's, see *Larus heermanni*.
 Herring, see *Larus argentatus*.
 Laughing, see *Larus atricilla*.
 Ring-billed, see *Larus delawarensis*.
 Short-billed, see *Larus brachyrhynchus*.
- Gymnogyps californianus*—California condor.
 Feeding on carrion, Fauna 7, p. 33.
- Gyr Falcon, Gray, see *Falco rusticolus*.
 White, see *Falco islandus*.
- H.**
- Habia ludoviciana*, see *Zamelodia ludoviciana*.
- Haliaeetus albicilla*—Gray sea eagle.
 Compiled information, Bul. 27, pp. 18-20.
- Haliaeetus leucocephalus*—Bald eagle.
 Brief account, Bul. 38, p. 40; Circ. 61,
 pp. 3, 13, 14; Ybk. 1894, pp. 217,
 227-228; Ybk. 1900, p. 430.
 Compiled information, Bul. 27, pp. 6-17.
 Equally beneficial and injurious, Ybk.
 1895, p. 590; Ybk. 1896, p. 628.
 Feeding on crustaceans and mollusks,
 Fauna 21, p. 43; rabbits, Ybk. 1907,
 p. 336; spermophiles, Bul. 4, p. 16.
 Food at Marshall Hall, Bul. 17, pp. 19,
 50, 53.
- Haliaeetus leucocephalus*—Continued.
 Formal report, Bul. 3, pp. 15, 97-101
 (21 stomachs); Rept. 1887, p. 413
 (6 stomachs).
 Protected in some States, Ybk. 1899,
 p. 266.
- Harporhynchus lecontei*, see *Toxostoma lecontei*.
- Harporhynchus rufus*, see *Toxostoma rufum*.
- Hawk, Broad-winged, see *Buteo platypterus*.
 Buzzard, see *Buteo buteo*.
 Cooper's, see *Accipiter cooperi*.
 Duck, see *Falco peregrinus*.
 Ferruginous rough-legged, see *Archibuteo ferrugineus*.
 Harris's, see *Parabuteo unicinctus harrisi*.
 Marsh, see *Circus hudsonius*.
 Mexican black, see *Urubutinga anthracina*.
 Pigeon, see *Falco columbarius*.
 Red-shouldered, see *Buteo lineatus*.
 Red-tailed, see *Buteo borealis*.
 Richardson's, see *Falco columbarius*.
 Rough-legged, see *Archibuteo lagopus sancti-johannis*.
 Rough-legged buzzard, see *Archibuteo lagopus lagopus*.
 Sennett's white-tailed, see *Buteo albicaudatus sennetti*.
 Sharp-shinned, see *Accipiter velox*.
 Short-tailed, see *Buteo brachyurus*.
 Sparrow, see *Falco sparverius*.
 Squirrel, see *Archibuteo ferrugineus*.
 Swainson's, see *Buteo swainsoni*.
 Zone-tailed, see *Buteo abbreviatus*.
- Heath hen, see *Tympanuchus cupido*.
- Heleodytes brunneicapillus couesi*—Cactus wren.
 Feeding on scale insects, Ybk. 1906, p.
 194.
 Food in California, Bul. 30, pp. 64-65
 (41 stomachs).
- Helminthophila celata lutescens*, see *Vermivora celata lutescens*.
- Helmitheros vermivorus*—Worm-eating warbler.
 Brief account, Bul. 38, p. 75.
 Feeding on scale insects, Ybk. 1906,
 p. 195.
 Food at Marshall Hall, Bul. 17, pp.
 34, 103-104.
- Helodromas solitarius*—Solitary sandpiper.
 Feeding on grasshoppers, Circ. 79, p. 4.
 Food at Marshall Hall, Bul. 17, p. 19.
- Herodias egretta*—Egret.
 Feeding on field mice, Bul. 31, p. 52.
- Heron, Black-crowned night, see *Nycticorax nycticorax naevius*.
 Great blue, see *Ardea herodias*.
 Green, see *Butorides virescens*.
 Little blue, see *Florida caerulea*.

Hesperiphona vespertina—Evening grosbeak.
 Brief account, Bul. 32, p. 5.
 Feeding on cedar berries (*Juniperus occidentalis*), Fauna 16, pp. 123, 139; weed seeds, Ybk. 1898, p. 230.
Himantopus knudseni—Kukuluaeo.
 Feeds on caterpillars and cutworms, protected in Hawaii, Bul. 12 (rev.), p. 87.
Himantopus mexicanus—Black-necked stilt.
 Feeding on bill bugs, crayfishes, Circ. 79, p. 6; Dytiscidae, Circ. 79, p. 8; grasshoppers, Circ. 79, p. 4.
Hirundo erythrogastra—Barn swallow.
 Brief account, Bul. 38, p. 71; F. Bul. 54, p. 31; F. Bul. 54 (rev.), pp. 36-38; Ybk. 1900, p. 418.
 Destroying nests and brood of English sparrows, Bul. 1, p. 282.
 Feeding on bayberries, Rept. 1890, p. 282; boll weevil, Bul. 29, pp. 6, 13-14, 25, 30; Bul. 38, p. 71; Circ. 56, pp. 1-2; Circ. 57, p. 2; Circ. 64, p. 5.
 Food at Marshall Hall, Bul. 17, pp. 20, 24, 25, 26, 34, 35, 36, 40, 46, 98-99 (10 stomachs).
 Food in California, Bul. 30, pp. 30-32 (82 stomachs).
 Food of nestlings, Ybk. 1900, p. 418.
 Protection urged, as enemy of boll weevil, Circ. 56, pp. 1-2; Circ. 57, p. 2.
 Relation to bedbugs, Circ. 57, p. 2.
Hirundo rustica—Old-world Swallow.
 Value as insect destroyer, Rept. 1886, p. 244.
Hirundo urtica, see *Chelidonaria urtica*.
 Humming bird, Grayson's, see *Amizillis graysoni*.
 Ruby-throated, see *Archilochus colubris*.
Hydrochelidon nigra surinamensis—Black tern.
 Feeding on imago of cotton-boll worm, Ybk. 1908, p. 194.
Hylocichla aliciae—Gray-checked thrush.
 Brief account, Bul. 38, p. 91.
 Food at Marshall Hall, Bul. 17, pp. 20, 24, 29, 32, 34, 35, 38, 108.
Hylocichla fuscescens—Veery.
 Brief account, Bul. 38, p. 90.
 Food at Marshall Hall, Bul. 17, p. 20.
Hylocichla guttata—Hermit thrush.
 Beneficial, Ybk. 1907, p. 169.
 Brief account, Bul. 38, p. 91.
 Feeding on berries of *Celastrus scandens*, Bul. 1, p. 273; potato beetle, Bul. 32, p. 47.
 Food at Marshall Hall, Bul. 17, p. 20.
 Food in California, Bul. 30, pp. 92-93 (68 stomachs).
Hylocichla mustelina—Wood thrush.
 Beneficial, Ybk. 1907, p. 169.
 Brief account, Bul. 38, p. 90.

Hylocichla mustelina—Continued.
 Feeding on mulberries, Rept. 1890, p. 285; potato beetle, Bul. 32, p. 47.
 Food at Marshall Hall, Bul. 17, p. 20.
Hylocichla ustulata—Olive-backed thrush.
 Feeding on potato beetle, Bul. 32, p. 47; spiders, Fauna 27, p. 493.
 Food at Marshall Hall, Bul. 17, pp. 20, 29, 34, 38, 40, 108.
 Food in California, Bul. 30, pp. 13, 86-92 (157 stomachs).
 Relation to fruit in California, Ybk. 1904, pp. 246, 251.

I.

Ibis, Wood, see *Mycteria americana*.
Icteria virens—Yellow-breasted chat.
 Brief account, Bul. 38, p. 82.
 Feeding on boll weevil, Bul. 29, pp. 6, 21, 25, 30; Circ. 64, p. 5.
 Food at Marshall Hall, Bul. 17, pp. 18, 24, 29, 34, 35, 37, 38, 40, 103-104.
Icterus bullocki—Bullock's oriole.
 Brief account, F. Bul. 54 (rev.), p. 29 (70 stomachs).
 Feeding on boll weevil, Bul. 25, pp. 9, 10-11, 18, 20, 21; Bul. 29, pp. 6, 16, 25, 30; Circ. 64, p. 5; cherries, Bul. 34, p. 54; codling moth, Rept. 1904, p. 293; cotton worm, Bul. 25, p. 20; scale insects, Ybk. 1906, p. 194.
 Food in California, Bul. 34, pp. 54, 68-71 (162 stomachs).
 Relation to fruit in California, Bul. 30, p. 13; Ybk. 1904, pp. 246, 251.
Icterus galbula—Baltimore oriole.
 Beneficial, Ybk. 1897, p. 670.
 Brief account, Bul. 38, p. 59; F. Bul. 54, pp. 23-24 (113 stomachs); F. Bul. 54 (rev.), p. 28 (202 stomachs); Ybk. 1900, p. 298.
 Feeding on boll weevil, Bul. 22, p. 16; Bul. 25, pp. 9, 10-11, 18, 20, 21; Bul. 29, pp. 6, 16, 24, 25, 30; Bul. 38, p. 59; Circ. 64, p. 5; cherries, Bul. 1, p. 60; cotton worms, Bul. 25, p. 20; grapes, Bul. 1, p. 324; Ybk. 1904, p. 251; mulberries, Rept. 1890, p. 285; peas, Bul. 1, p. 60; scale insects, Ybk. 1906, p. 197; tent caterpillars, tussock moth caterpillars, Bul. 1, pp. 108, 324; Rept. 1886, p. 244.
 Food at Marshall Hall, Bul. 17, pp. 28, 30, 40, 59, 60, 96.
 Food of nestlings, Ybk. 1900, p. 422.
 Formal report, Ybk. 1895, pp. 419-420, 426-430 (113 stomachs).
 Other notes, Bul. 34, pp. 68, 69.
 Reference to studies of food habits, Ybk. 1899, p. 266.
 Relation to orchards, Ybk. 1900, p. 298.

Icterus graysoni—Grayson's oriole.

Feeding on fig, Fauna 14, p. 61; fruit of *Cereus*, insects, spiders, weevils, Fauna 14, p. 51.

Icterus spurius—Orchard oriole.

Brief account, Bul. 38, p. 59.

Feeding on boll weevil, Bul. 25, pp. 9, 10-11, 16, 17, 18, 20, 21; Bul. 29, pp. 6, 16, 24, 25, 29, 30; Bul. 38, p. 59; Circ. 64, p. 5; cotton worms, Bul. 25, p. 20; mulberries, Rept. 1890, p. 285; scale insects, Ybk. 1906, p. 197.

Food at Marshall Hall, Bul. 17, pp. 17, 24, 25, 30, 32, 34, 35, 40, 44-45, 49, 55, 56, 59, 60, 61, 96, 110 (11 stomachs).

Food of nestlings, Ybk. 1900, p. 422.

Request for information on economic relations, Ent. Circ. 20 [p. 21].

Ictinia mississippiensis—Mississippi kite.

Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 31, p. 45; Bul. 38, p. 37; Circ. 61, pp. 3, 4; Rept. 1887, p. 403; Ybk. 1894, pp. 217, 218.

Formal report, Bul. 3, pp. 11, 24-25.

Iridoprocne bicolor—Tree swallow.

Feeding on bayberries, Bul. 30, p. 27; Rept. 1890, p. 282.

Food at Marshall Hall, Bul. 17, pp. 20, 24, 34, 35, 39, 40, 98-99 (5 stomachs).

Insectivorous, Bul. 1, p. 96.

Other notes, Bul. 30, p. 27; Circ. 56, pp. 1-2; F. Bul. 54, p. 31; F. Bul. 54 (rev.), pp. 36-38.

Ixobrychus exilis—Least bittern.

Feeding on field mice, Bul. 31, p. 52.

Food at Marshall Hall, Bul. 17, p. 19.

Ixoreus naevius—Varied thrush.

Feeding on scale insects, Ybk. 1906, pp. 197, 198.

J.

Jacksnipe, see *Gallinago delicata*.

Jaeger, Parasitic, see *Stercorarius parasiticus*.

Pomarine, see *Stercorarius pomarinus*.

Jay, Blue, see *Cyanocitta cristata*.

California, see *Aphelocoma californica*.

Canada, see *Perisoreus canadensis*.

Old-world, see *Garrulus glandarius*.

Piñon, see *Cyanocephalus cyanocephalus*.

Steller's, see *Cyanocitta stelleri*.

Woodhouse's, see *Aphelocoma woodhousei*.

Junco hyemalis—Snowbird.

Brief account, Bul. 38, p. 65.

Feeding on weed seeds, Bul. 9, p. 17; Ybk. 1898, pp. 222, 225, 226, 227.

Junco hyemalis—Continued.

Food at Marshall Hall, Bul. 17, pp. 16-17, 30, 34, 35, 38, 71, 73, 74, 75 (11 stomachs).

Food in California, Bul. 34, pp. 82-83, 84 (269 stomachs).

Formal report, Bul. 15, pp. 18, 27, 28, 37, 38, 39, 41, 42, 43, 44, 45, 46, 80-82 (299 stomachs).

Other notes, F. Bul. 54, p. 28; F. Bul. 54 (rev.), p. 32.

K.

Kea, see *Nestor notabilis*.

Killdeer, see *Oxyechus vociferus*.

Kingbird, see *Tyrannus tyrannus*.

Arkansas, see *Tyrannus verticalis*.

Cassin's, see *Tyrannus vociferans*.

Kingfisher, Belted, see *Ceryle alcyon*.

Kinglet, Golden-crowned, see *Regulus satrapa*.

Ruby-crowned, see *Regulus calendula*.

Kite, Everglade, see *Rostrhamus sociabilis*.

Mississippi, see *Ictinia mississippiensis*.

Swallow-tailed, see *Elainoides forficatus*.

White-tailed, see *Elanus leucurus*.

Kittiwake, Pacific, see *Rissa tridactyla pollicaris*.

Knot, see *Tringa canutus*.

Kohlmeise, see *Parus major*.

Kukuluaeo, see *Himantopus knudseni*.

L.

Lagopus lagopus—Willow ptarmigan.

Feeding on aments of dwarf birch, Fauna 24, p. 66; Fauna 27, p. 342; bearberries (*Mairantia alpina*), Fauna 27, p. 343; blueberries, Fauna 24, p. 66; (*Vaccinium uliginosum*) Fauna 27, p. 343; buds, Fauna 24, p. 66; of *Populus balsamifera*, buds and twigs of willows (*Salix bebbiana*), Fauna 27, p. 343; crowberries (*Empetrum nigrum*), Fauna 24, p. 66; Fauna 27, p. 343; foliage, Bul. 24, p. 66; of dwarf birch (*Betula nana*), Fauna 27, p. 343; of dwarf willow (*Salix reticulata*), Fauna 27, pp. 342, 343; of grass, Fauna 27, p. 343; of *Populus balsamifera*, Fauna 27, p. 342; of vetch (*Aragallus*), Fauna 27, pp. 342, 343; of wild rosemary (*Andromeda polifolia*), Fauna 27, p. 342; fruit of *Andromeda polifolia*, mountain cranberries (*Vitisidæa*), mushrooms, Fauna 27, p. 343; seeds of grass, Fauna 27, pp. 343, 344; of *Hedysarum americanum*, Fauna 27, p. 343.

Formal report, Bul. 24, pp. 44-46 (5 stomachs).

- Lagopus leucurus*—White-tailed ptarmigan.
Brief account, Bul. 24, pp. 47-48.
- Lagopus rupestris*—Rock ptarmigan.
Brief account, Bul. 24, pp. 46-47.
Feeding on aments of *Alnus viridis*, Fauna 24, p. 67; blueberries, Fauna 30, p. 37; buds of willow, Fauna 24, p. 67; Fauna 30, p. 87; buds and twigs of *Vaccinium*, Bul. 24, p. 67; crowberries, Fauna 30, p. 37; foliage of *Dryas*, Fauna 24, p. 67; Fauna 30, p. 37; of *Ledum*, Fauna 24, p. 67; fruit of *Cassiope*, Fauna 30, p. 37.
- Lanius borealis*—Big butcher bird.
Brief account, Ybk. 1900, pp. 301-302.
Feeding on bird (chasing), Fauna 5, p. 105; English sparrow, Bul. 1, pp. 31, 150, 233, 234, 238; Rept. 1886, p. 245; field mice, Bul. 31, pp. 51-52; meat and camp refuse, Fauna 30, p. 63; robin (chasing), Fauna 27, p. 459; spotted sandpiper (chasing), Fauna 30, pp. 36, 42.
Formal report, Bul. 9, pp. 15, 16, 17-20, 24-25, 26 (67 stomachs).
Other notes, Bul. 1, pp. 150, 234; Rept. 1886, p. 245.
Reference to studies of food habits, Ybk. 1899, p. 266.
Relation to orchards, Ybk. 1900, pp. 301-302.
- Lanius excubitor*—European great butcher bird.
Brief account, Bul. 9, pp. 15, 19.
- Lanius ludovicianus*—Little butcher bird.
Brief account, Bul. 38, p. 73; Ybk. 1900, pp. 302, 416-417.
Feeding on beetles, Bell's vireo (*Vireo bellii*), blue-gray gnatcatcher (*Poliophtila caerulea*), Bul. 2, p. 233; boll weevil, Bul. 22, p. 16; Bul. 25, pp. 9, 14-15, 21; Bul. 29, pp. 6, 22, 30; Circ. 64, p. 5; carrion, Bul. 2, p. 233; field mice, Bul. 31, p. 52; Ybk. 1905, p. 371; (*Microtus montanus*) F. Bul. 335, p. 12; F. Bul. 352, p. 21; grasshoppers, Bul. 2, p. 233; grasshopper mice (*Perognathus*), insects, lizards, Fauna 7, p. 114; western chipping sparrow (*Spizella passerina zonae*), Bul. 2, p. 233.
Food at Marshall Hall, Bul. 17, pp. 54, 100-102.
Food in California, Bul. 30, pp. 33-38 (124 stomachs).
Food of nestlings, Ybk. 1900, pp. 416-417.
Formal report, Bul. 9, pp. 15, 16, 17, 20-24, 25-26 (88 stomachs).
Other notes, Bul. 30, p. 35.
Reference to studies of food habits, Ybk. 1899, p. 266.
Relation to orchards, Ybk. 1900, p. 302.
- Lanivireo flavifrons*—Yellow-throated vireo.
Brief account, Bul. 38, p. 74.
- Lanivireo solitarius cassini*—Cassin's vireo.
Feeding on scale insects, Ybk. 1906, p. 194.
Food in California, Bul. 30, pp. 40-41 (46 stomachs).
- Lark, Horned, see *Otocoris alpestris*.
Meadow, see *Sturnella magna*.
Shore, see *Otocoris alpestris*.
Western meadow, see *Sturnella neglecta*.
- Larus argentatus*—Herring gull.
Eating frozen moose meat, Fauna 30, p. 84.
Food at Marshall Hall, Bul. 17, pp. 53, 80.
Food of young in captivity, Ybk. 1900, p. 434.
- Larus atricilla*—Laughing gull.
Food of nestlings, Ybk. 1900, p. 434.
- Larus brachyrhynchus*—Short-billed gull.
Feeding on water beetles (*Dytiscus dauricus*), Fauna 27, p. 268.
Food of nestlings, Ybk. 1900, p. 434.
- Larus californicus*—California gull.
Feeding on duck [probably carrion], Fauna 7, p. 14; field mice, Ybk. 1908, p. 194.
- Larus delawarensis*—Ring-billed gull.
Feeding on field mice, Ybk. 1908, p. 194.
Food at Marshall Hall, Bul. 17, pp. 53, 80.
- Larus franklini*—Franklin's gull.
Feeding on crickets, Ybk. 1908, p. 194; grasshoppers, Rept. 1887, p. 431; Ybk. 1908, p. 194.
Food of nestlings, Ybk. 1900, p. 434.
Insectivorous, Rept. 1900, p. 37.
- Larus glaucescens*—Glaucous-winged gull.
Feeding on dead salmon, Fauna 24, p. 53.
- Larus heermanni*—Heermann's gull.
Feeding on fish they compelled gannets to disgorge, Fauna 14, p. 24.
- Larus marinus*—Great black-backed gull.
Feeding on field mice in Europe, Bul. 31, p. 53.
- Leucosticte tephrocotis*—Gray-crowned rosy finch.
Feeding on insects and seeds, Fauna 7, p. 82.
- Ligurinus chloris*, see *Chloris chloris*.
- Limosa fedoa*—Marbled godwit.
Feeding on grasshoppers, Circ. 79, p. 4.
- Limosa haemastica*—Hudsonian godwit.
Feeding on horseflies, Circ. 79, p. 4.
- Linaria cannabina*—Old-world linnet.
Injurious in New Zealand, Ybk. 1909, p. 257.
- Linnet, California, see *Carpodacus mexicanus frontalis*.
Old-world, see *Linaria cannabina*.

Lobipes lobatus—Northern phalarope.

Feeding on click beetles, clover-root curculio, Circ. 79, p. 6; crane flies, Circ. 79, p. 4; Dytiscidae, Circ. 79, p. 8; grasshoppers, Circ. 79, p. 4; mosquitoes, Circ. 79, p. 2; Rept. 1908, p. 577; *Nereis*, Circ. 79, p. 8; wire-worms, Circ. 79, p. 6.

Longspur, Chestnut-collared, see *Calcarius ornatus*.

Lapland, see *Calcarius lapponicus*.

McCown's, see *Rhynchophanes mccowni*.

Smith's, see *Calcarius pictus*.

Loon, Black-throated, see *Gavia arctica*.

Red-throated, see *Gavia stellata*.

Lophodytes cucullatus—Hooded merganser.

Brief account, Bul. 38, p. 17.

Food at Marshall Hall, Bul. 17, pp. 53, 81.

Lophortyx californica—California quail.

Damage to fruit, Ybk. 1898, p. 231; grain, Ybk. 1897, p. 352.

Feeding on acorns, Fauna 7, p. 28; weed seeds, Ybk. 1898, p. 231.

Food in California, Bul. 34, pp. 9-14 (619 stomachs).

Formal report, Bul. 21, pp. 9, 47-56 (601 stomachs).

Killed by eating poisoned wheat, F. Bul. 352, p. 8.

Relation to fruit in California, Bul. 30, p. 13; Ybk. 1904, pp. 246, 250.

Lophortyx gambeli—Gambel's quail.

Damage to fruit, Ybk. 1898, p. 231.

Feeding on waste grain, Fauna 7, p. 29; weed seeds, Ybk. 1898, p. 231.

Formal report, Bul. 21, pp. 56-58 (28 stomachs).

Love bird, Tres Marias, see *Psittacula insularis*.

Feeding on seeds of pine and sun-flower, Fauna 16, p. 123.

Loxia curvirostra minor—Crossbill.**Loxia leucoptera**—White-winged crossbill.

Feeding on seeds of white spruce, Fauna 27, p. 417.

Lunda clarrhata—Tufted puffin.

Food of nestlings, Ybk. 1900, p. 433.

M.**Macrorhamphus griseus**—Dowitcher.

Feeding on Dytiscidae, Circ. 79, p. 8; grasshoppers, horseflies, Circ. 79, p. 4; *Nereis*, Circ. 79, p. 8.

Magpie, see *Pica pica hudsonia*.**Mallard**, see *Anas platyrhynchos*.**Mareca americana**—Widgeon.

Brief account, Bul. 38, p. 18.

Food at Marshall Hall, Bul. 17, p. 81.

Vegetable food, Circ. 81, pp. 1, 8.

Marila affinis—Little bluebill.

Food at Marshall Hall, Bul. 17, p. 81.

Vegetable food, Circ. 81, pp. 1, 8.

Marila americana—Redhead.

Brief account, Bul. 38, p. 21.

Vegetable food, Circ. 81, pp. 1, 8, 12.

Marila collaris—Ring-necked duck.

Brief account, Bul. 38, p. 21.

Marila marila—Big bluebill.

Feeding on *Lymanea*, Fauna 27, p. 283.

Vegetable food, Circ. 81, pp. 1, 8.

Marila valisineria—Canvasback.

Brief account, Bul. 38, p. 21.

Food at Marshall Hall, Bul. 17, pp. 81, 82.

Vegetable food, Circ. 81, pp. 1, 7-8, 11-12.

Martin, Old-world, see *Chelidonaria urbana*.

Purple, see *Progne subis*.

Maryland yellowthroat, see *Geothlypis trichas*.**Meadowlark**, see *Sturnella magna*.

Western, see *Sturnella neglecta*.

Megaquiscalus major—Boat-tailed black-bird.

Bounty laws, Ybk. 1896, p. 57.

Damage to corn, Bul. 29, p. 8; rice, Rept. 1886, pp. 246-247.

Feeding on boll weevil, Bul. 22, p. 16; Bul. 25, pp. 9, 10, 12, 21; Bul. 29, pp. 6, 7, 11, 17-18, 29, 30; Circ. 64, p. 5.

Formal report, Bul. 13, pp. 9, 10, 70-72 (116 stomachs).

Megascops asio, see *Otus asio*.**Megascops flammeola**, see *Otus flammeolus*.**Melanerpes carolinus**, see *Centurus carolinus*.**Melanerpes erythrocephalus**—Red-headed woodpecker.

Brief account, Bul. 38, p. 48; F. Bul. 54, pp. 8-9, 10; F. Bul. 54 (rev.), pp. 11-12, 13; Ybk. 1900, p. 295.

Damage to buildings, Bul. 39, p. 13; poles, Bul. 39, p. 10; posts, Bul. 39, p. 13.

Feeding on rose beetle, Bul. 32, p. 20; scale insects, Ybk. 1906, p. 197.

Food at Marshall Hall, Bul. 17, pp. 19, 43, 60, 61, 90.

Formal report, Bul. 7, pp. 8, 9, 10, 11, 20-25, 38 (101 stomachs); Bul. 37, pp. 10, 35-42 (443 stomachs).

Relation to orchards, Ybk. 1900, p. 295.

Tapping trees, Bul. 39, p. 91.

Melanerpes formicivorus bairdi—California woodpecker.

Damage to buildings, Bul. 39, p. 14; poles, Bul. 39, p. 11; posts, Bul. 39, p. 13.

Feeding on acorns, Bul. 7, p. 20; Fauna 7, p. 50; grasshoppers, Fauna 7, p. 50; scale insects, Ybk. 1906, p. 194.

Food in California, Bul. 34, pp. 22-24, 28, 49 (75 stomachs).

Melanerpes formicivorus bairdi—Continued.
 Formal report, Bul. 37, pp. 10, 43-45, 46 (84 stomachs).
 Tapping trees, Bul. 39, p. 91.
 Visiting sapsucker punctures, Bul. 39, p. 92.

Melanerpes torquatus, see *Asyndesmus lewisi*.

Meleagris gallopavo merriami—Merriam's turkey.
 Feeding on gooseberries, piñon nuts, Fauna 3, p. 89; (*Pinus monophylla*) Fauna 7, p. 337.

Meleagris gallopavo silvestris—Wild turkey.
 Damage to grain, Bul. 24, p. 9.
 Economic value, Ybk. 1902, p. 206.
 Formal report, Bul. 24, pp. 48-52 (16 stomachs).

Melospiza georgiana—Swamp sparrow.
 Feeding on boll weevil, Circ. 64, pp. 3, 5.
 Formal report, Bul. 15, p. 87 (72 stomachs).

Melospiza lincolni—Lincoln's sparrow.
 Formal report, Bul. 15, pp. 15, 86 (31 stomachs).

Melospiza melodia—Song sparrow.
 Beneficial, Ybk. 1897, p. 670.
 Brief account, Bul. 38, p. 66; F. Bul. 54, pp. 26-27, 28; F. Bul. 54 (rev.), 31-32.
 Feeding on insects, Bul. 1, pp. 295, 323; Fauna 21, p. 48; mulberries, Rept. 1890, p. 285; sand fleas, Fauna 21, p. 48; weed seeds, Ybk. 1898, pp. 222, 223, 224, 225, 226, 227.
 Food at Marshall Hall, Bul. 17, pp. 16, 22, 23, 26, 27, 30, 32, 33, 34, 35, 36, 38, 39, 40, 59, 60, 61, 70, 71, 72, 73, 75, 77, 97 (36 stomachs).
 Food in California, Bul. 34, pp. 84-86 (321 stomachs).
 Formal report, Bul. 15, pp. 13, 15, 21, 24, 26, 27, 28, 31, 32, 37, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 82-86 (401 stomachs).

Merganser, Hooded, see *Lophodytes cucullatus*.

Merula migratoria, see *Planesticus migratorius*.

Micropalama himantopus—Stilt sandpiper.
 Feeding on mosquitoes, Circ. 79, p. 2; *Nereis*, Circ. 79, p. 8.

Micropallas whitneyi—Elf owl.
 Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.
 Brief account, Bul. 3, pp. 11, 200-201.

Mimus polyglottos—Mocking bird.
 Brief account, Bul. 38, p. 84; Ybk. 1900, p. 416.
 Damage to fruit, Bul. 30, p. 53; Rept. 1890, p. 281.

Mimus polyglottos—Continued.
 Feeding on boll weevil, Bul. 22, p. 16; Bul. 25, pp. 9, 14, 21; Bul. 29, pp. 6, 22, 23, 30; Bul. 38, p. 84, Circ. 64, p. 5; cotton worms, Bul. 25, pp. 20, 21.
 Food at Marshall Hall, Bul. 17, pp. 34, 38, 62, 104, 110.
 Food in California, Bul. 30, pp. 52-55 (53 stomachs).
 Food of nestlings, Ybk. 1900, p. 416.
 Formal report, Ybk. 1895, pp. 405, 406, 415-416 (15 stomachs).
 Reference to studies of food habits, Ybk. 1899, p. 266.

Mniotilta varia—Black-and-white creeper.
 Brief account, Bul. 38, p. 75.

Mocking bird, see *Mimus polyglottos*.

Molothrus ater—Cowbird.
 Brief account, Bul. 38, p. 57.
 Damage to fruit, Bul. 1, p. 246; grain, Rept. 1887, pp. 428, 429, 430-431; Rept. 1898, p. 39; Ybk. 1897, p. 352; Ybk. 1898, p. 222; rice, Bul. 38, p. 57.
 Feeding on boll weevil, Bul. 22, p. 16; Bul. 25, pp. 8, 9, 12, 21; Bul. 29, pp. 6, 7, 18, 28, 30; Circ. 64, p. 5; mulberries, Rept. 1890, p. 285; weed seeds, Bul. 29, p. 8; Ybk. 1898, p. 222.
 Food at Marshall Hall, Bul. 17, pp. 14, 32, 35, 70, 71, 77, 95, 111.
 Formal report, Bul. 13, pp. 9, 22-30 (544 stomachs).
 Other notes, Bul. 15, p. 20.

Munia nisoria, see *Padda oryzivora*.

Munia oryzivora, see *Padda oryzivora*.

Murre, Pallas's, see *Uria lomvia arra*.

Muscivora forficata—Scissor-tailed flycatcher.
 Feeding on boll weevil, Bul. 22, p. 16; Bul. 25, pp. 8, 13, 19, 20, 21; Bul. 29, pp. 6, 15, 26, 30; Circ. 64, p. 5.

Myadestes townsendi—Solitaire.
 Feeding on berries of *Juniperus occidentalis*, Fauna 16, pp. 123, 133, 139.

Mycteria americana—Wood ibis.
 Feeding on field mice, Bul. 31, p. 52.

Myiarchus cinerascens—Ash-throated flycatcher.
 Food in California, Bul. 34, pp. 29-32 (80 stomachs).
 Other notes, Fauna 7, p. 60.

Myiarchus crinitus—Crested flycatcher.
 Brief account, Bul. 38, p. 53.
 Feeding on boll weevil, Bul. 29, pp. 6, 14, 15, 23, 29, 30; Circ. 64, p. 5.
 Food at Marshall Hall, Bul. 17, pp. 19-20, 23, 24, 29, 30, 32, 34, 35, 37, 38, 40, 93.
 Food of nestlings, Ybk. 1900, p. 426.

Myiochanes richardsoni—Western wood pewee.
 Feeding on flies (*Ephydra hians*), Fauna 7, p. 64.

Myiochanes richardsoni—Continued.

Food in California, Bul. 34, pp. 37, 39-41 (137 stomachs).

Myiochanes virens—Wood pewee.

Brief account, Bul. 38, p. 54; Ybk. 1900, p. 427.

Feeding on mulberries, Rept. 1890, p. 285.

Food at Marshall Hall, Bul. 17, pp. 19, 23, 24, 29, 30, 34, 35, 37, 40, 92 (11 stomachs).

Food of nestlings, Ybk. 1900, p. 427.

Myna, Common, see *Acridotheres tristis*.

N.

Nannus hiemalis—Winter wren.

Brief account, Bul. 30, pp. 65-66.

Feeding on boll weevil, Circ. 64, pp. 4, 5.

Food at Marshall Hall, Bul. 17, p. 107.

Nestor notabilis—Kea.

Killed soon after arrival in Hawaii because of reputation as sheep destroyer, Rept. 1904, pp. 296-297.

Nettion carolinense—Green-winged teal.

Brief account, Bul. 38, p. 19.

Vegetable food, Circ. 81, p. 1.

Nighthawk, see *Chordeiles virginianus*.

Texas, see *Chordeiles acutipennis texensis*.

Nucifraga columbiana—Clarke's crow.

Feeding on beetles, blueberries, caterpillars, grasshoppers, Fauna 16, pp. 119-121; piñon nuts, Fauna 3, p. 94; seeds of *Pinus albicaulis*, Fauna 16, p. 119.

Food of adults and nestlings, Ybk. 1900, p. 426.

Other notes, Fauna 5, pp. 18, 100.

Numenius americanus—Long-billed curlew.

Feeding on grasshoppers, Circ. 79, p. 2.

Numenius hudsonicus—Hudsonian curlew.

Feeding on crowberries (*Empetrum nigrum*), Fauna 27, p. 331; Ybk. 1903, p. 377.

Nun, Japanese, see *Uroloncha acuticauda*.*Nutcracker*, Clarke's, see *Nucifraga columbiana*.*Nuthatch*, Pygmy, see *Sitta pygmaea*.

Red-breasted, see *Sitta canadensis*.

White-breasted, see *Sitta carolinensis*.

Nuttallornis borealis—Olive-sided flycatcher.

Feeding on boll weevil, Bul. 29, pp. 6, 15, 24, 30; Circ. 64, p. 5.

Nyctala acadica, see *Cryptoglaux acadica*.*Nyctala tengmalmi richardsoni*, see *Cryptoglaux funerea richardsoni*.*Nyctea nyctea*—Snowy owl.

Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Circ. 61, pp. 3, 13; Ybk. 1894, pp. 217, 226.

Nyctea nyctea—Continued.

Feeding on brown rat, Bul. 33, p. 35; field mice, Bul. 31, p. 50; Ybk. 1905, p. 371; pocket gophers, Bul. 5, p. 21; rabbits, Ybk. 1907, p. 336; spermophiles, Bul. 4, pp. 15, 16; varying hares (*Lepus americanus*), Fauna 27, p. 375.

Formal report, Bul. 3, pp. 11, 182-187 (38 stomachs); Rept. 1887, p. 422 (6 stomachs).

Nycticorax nycticorax naevius—Black-crowned night heron.

Brief account, Bul. 38, p. 26; Ybk. 1900, p. 435.

Feeding on carp, Fauna 7, p. 20; field mice, Bul. 31, p. 52.

Food at Marshall Hall, Bul. 17, pp. 53, 81.

Food of nestlings, Ybk. 1900, p. 435.

Injurious to fish, hence exempt from protection in certain States, Bul. 12, p. 36; Bul. 12 (rev.), p. 43.

O.

Oceanodroma melania—Black petrel.

Feeding on refuse from vessel, Fauna 14, p. 28.

Oidemia americana—Scoter.

Feeding on newly sown millet, Bul. 2, p. 73.

Oidemia deglandi—White-winged scoter.

Feeding on wild celery, Circ. 81, p. 8.

Olbiorchilus hiemalis, see *Nannus hiemalis*.*Olor columbianus*—Whistling swan.

Food at Marshall Hall, Bul. 17, p. 81.

Oreortyx picta—Mountain quail.

Formal report, Bul. 21, pp. 58-60 (23 stomachs).

Oreoscoptes montanus—Sage thrasher.

Feeding on buffalo berries, Fauna 33, p. 241.

Oreospiza chlorura—Green-tailed towhee.

Feeding on weed seeds, Ybk. 1898, p. 230.

Oriole, Baltimore, see *Icterus galbula*.

Bullock's, see *Icterus bullocki*.

Grayson's, see *Icterus graysoni*.

Orchard, see *Icterus spurius*.

Osprey, see *Pandion halliaëtus carolinensis*.*Otocoris alpestris*—Horned lark.

Brief account, Rept. 1905, pp. 305-306.

Damage to grain, Ybk. 1897, p. 352; newly sown wheat, Fauna 7, p. 68.

Feeding on weed seeds, Ybk. 1898, pp. 222, 230, 232.

Food at Marshall Hall, Bul. 17, pp. 70, 71, 93.

Food in California, Bul. 23, pp. 9, 30-32 (267 stomachs); Bul. 34, pp. 44-47 (259 stomachs).

Food in Europe (of the subspecies *flava*) similar to that of American races, Bul. 23, p. 11.

Otocoris alpestris—Continued.

Formal report, Bul. 23, pp. 7-37 (1,154 stomachs); Rept. 1892, pp. 193-197 (59 stomachs).

Killed by eating poisoned wheat, F. Bul. 352, p. 8.

Otus asio—Screech owl.

Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670.

Bounty laws, Ybk. 1899, p. 281.

Brief account, Bul. 31, pp. 49-50; Bul. 38, p. 43; Circ. 61, pp. 3, 12-13 (254 stomachs); Rept. 1889, pp. 372-376; Ybk. 1894, pp. 217, 225-226; Ybk. 1900, p. 430.

Feeding on brown rat, Bul. 33, p. 34; buckwheat, Bul. 2, p. 121; English sparrow, Bul. 1, pp. 32, 150, 238; Rept. 1886, p. 245; field mice, Bul. 31, pp. 49-50; Ybk. 1905, p. 371; horned larks, Bul. 23, p. 12; seeds, wheat, Bul. 2, p. 121.

Food at Marshall Hall, Bul. 17, pp. 19, 32, 56, 86 (5 stomachs).

Food of nestlings, Ybk. 1900, p. 430.

Formal report, Bul. 3, pp. 11, 14, 146, 163-173 (254 stomachs); Rept. 1887, pp. 420-421 (94 stomachs).

Other notes, Bul. 1, pp. 32, 150, 238; Rept. 1886, p. 245.

Otus flammeolus—Flammulated screech owl.

Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 3, pp. 11, 173-174; Rept. 1889, p. 376.

Feeding on beetles, other insects, and scorpion, Fauna 3, pp. 39, 91.

Ovenbird, see *Seiurus aurocapillus*.Owl, American barn, see *Aluco pratincola*.

Barred, see *Strix varia*.

Burrowing, see *Speotyto cunicularia hypogæa*.

Elf, see *Micropallas whitneyi*.

Ferruginous pygmy, see *Glaucidium phalaenoides*.

Flammulated screech, see *Otus flammeolus*.

Florida burrowing, see *Speotyto cunicularia floridana*.

Great gray, see *Scotiaptex nebulosa*.

Great horned, see *Bubo virginianus*.

Hawk, see *Surnia ulula caparoch*.

Long-eared, see *Asio wilsonianus*.

Old-world barn, see *Aluco flammeus*.

Old-world long-eared, see *Asio otus*.

Pygmy, see *Glaucidium gnoma*.

Richardson's, see *Cryptoglaux funerea richardsoni*.

Saw-whet, see *Cryptoglaux acadica*.

Screech, see *Otus asio*.

Short-eared, see *Asio flammeus*.

Snowy, see *Nyctea nyctea*.

Spotted, see *Strix occidentalis*.

Oxyechus vociferus—Killdeer.

Feeding on army worm, billbugs, Circ. 79, p. 6; boll weevils, Bul. 22, pp. 15, 16; Bul. 25, pp. 8, 9, 14, 21; Bul. 29, pp. 6, 7, 11, 20-21, 27, 30; Circ. 57, p. 4; Circ. 64, p. 5; Circ. 79, p. 6; click beetles, clover-leaf beetle, clover-root curculio, corn-leaf beetle, cotton worm, cotton cutworm, Circ. 79, p. 6; crane flies, Circ. 79, p. 4; crayfishes, cutworms, Circ. 79, p. 6; Dytiscidae, Circ. 79, p. 8; grapevine colaspis, Circ. 79, p. 6; grasshoppers, Circ. 79, p. 2; horseflies, Circ. 79, p. 4; mosquitoes, Circ. 79, p. 2; Rept. 1908, p. 577; *Nereis*, Circ. 79, p. 8; rice weevil, tobacco worm, wireworms, Circ. 79, p. 6.

Killed by eating poisoned grain, Ybk. 1908, p. 308.

Other notes, Bul. 22, pp. 15-16; Bul. 29, p. 27.

Oxeye, see *Parus major*.

P.

Padda oryzivora—Java sparrow.

Admission to Hawaii denied, Rept. 1909, p. 542.

Damages rice, Ybk. 1906, p. 177.

Injurious in Hawaii, Rept. 1902, p. 213.

Paddy bird, see *Padda oryzivora*.

Pandion haliaëtus carolinensis—Osprey.

Bounty laws, Ybk. 1899, pp. 266, 279, 280, 281.

Brief account, Bul. 38, p. 41.

Food at Marshall Hall, Bul. 17, pp. 19, 53.

Food of nestlings, Ybk. 1900, p. 430.

Formal report, Bul. 3, pp. 15, 16, 130-132 (12 stomachs).

Injurious, Bul. 38, p. 10.

Protected, or excepted from bounty laws in certain States, Bul. 12, p. 29; Bul. 12 (rev.), p. 32; Ybk. 1899, p. 266, 279.

Parabuteo unicinctus harrisi—Harris's hawk.

Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Feeding on cotton rat (*Sigmodon hispidus texianus*), Fauna 25, p. 116; rabbits, Ybk. 1907, p. 336; spermophiles, Bul. 4, pp. 16, 17; wood rat (*Neotoma micropus*), Fauna 25, p. 112.

Formal report, Bul. 3, pp. 11, 47-48 (6 stomachs).

Paroquet, Carolina, see *Conuropsis carolinensis*.Parrot, Double yellow-headed, see *Amazona oratrix*.

Mountain, see *Nestor notabilis*.

- Partridge, European common, see *Perdix perdix*.
 Hungarian, see *Perdix perdix*.
 Spruce, see *Canachites canadensis*.
- Parus atricapillus*, see *Penthestes atricapillus*.
- Parus bicolor*, see *Bæolophus bicolor*.
Parus caeruleus, see *Cyanistes caeruleus*.
Parus carolinensis, see *Penthestes carolinensis*.
- Parus gambeli*, see *Penthestes gambeli*.
Parus inornatus, see *Bæolophus inornatus*.
Parus major—Great titmouse.
 Admission denied, Rept. 1902, p. 213; Ybk. 1905, p. 545.
 Economic status, introduction dangerous, etc., Rept. 1899, p. 67; Ybk. 1898, pp. 90, 104–105, 107, 109, 110.
- Parus palustris*, see *Pœcile palustris*.
Parus rufescens, see *Penthestes rufescens*.
Parus wollweberi, see *Bæolophus wollweberi*.
- Passer domesticus*—English sparrow.
 Admission denied, Circ. 34, p. 7; F. Bul. 160, p. 48; F. Bul. 180, p. 42; F. Bul. 470, p. 301; Rept. 1900, p. 41.
 Admission to West Australia prohibited, Rept. 1899, p. 68.
 Bounty laws, Circ. 17, p. 4; Rept. 1899, p. 65; Ybk. 1896, pp. 55, 58, 59, 60, 61, 66, 67; Ybk. 1899, p. 265.
 Brief account, Bul. 9, pp. 17, 18, 20; Bul. 38, p. 60; F. Bul. 383, p. 5; Ybk. 1900, pp. 420–422.
 Driving other birds away, Bul. 29, p. 11; Ent. Circ. 20 [p. 2]; Circ. 2 [p. 1]; Circ. 56, pp. 2, 3; Circ. 57, pp. 3–4; F. Bul. 383, p. 6; Rept. 1907, p. 486; Schedule 4 [p. 1].
 Economic status, introduction dangerous, etc., F. Bul. 160, p. 48; F. Bul. 180, p. 42; Rept. 1886, p. 258; Rept. 1906, pp. 406, 415; Rept. 1907, p. 493; Ybk. 1898, pp. 90, 98–101, 104, 108, 109, 110; Ybk. 1899, pp. 287, 290, 292; Ybk. 1904, p. 515; Ybk. 1905, p. 546; Ybk. 1909, p. 249.
 Feeding on mulberries, Rept. 1890, p. 285; potato beetle, Bul. 32, p. 47; scale insects, Ybk. 1906, pp. 191, 196; weed seeds, Ybk. 1898, pp. 223–224, 225, 232.
 Food habits at Marshall Hall, Bul. 17, pp. 17, 23, 24, 28, 30, 34, 36, 38, 56, 61, 66, 68–69, 70, 98, 110 (53 stomachs).
 Food of nestlings, Ybk. 1900, pp. 420–422, 436.
 Formal report, Bul. 1, pp. 1–405 (636 stomachs); Bul. 15, pp. 15, 17, 21, 26, 27, 31, 32, 34, 39, 40, 48, 49, 50, 92–96 (798 stomachs); Rept. 1886, pp. 235–246.
- Passer domesticus*—Continued.
 Injurious, Bul. 12, pp. 13, 35, 36; Bul. 12 (rev.), pp. 20, 21, 42; Bul. 31, pp. 38, 43, 45, 60; F. Bul. 160, p. 48; F. Bul. 180, p. 42; F. Bul. 470, p. 30; Rept. 1886, p. 258; Rept. 1889, p. 374; Rept. 1891, p. 271; Rept. 1899, pp. 68–69; Rept. 1901, p. 160; Rept. 1906, pp. 406, 415; Rept. 1907, pp. 500–501; Ybk. 1895, p. 418; Ybk. 1897, p. 670; Ybk. 1898, pp. 223, 232; Ybk. 1904, p. 515; Ybk. 1905, p. 546; Ybk. 1907, pp. 173–174, 177; Ybk. 1909, p. 249.
 Injurious in Australasia, Rept. 1899, pp. 68–69; Hawaii, Rept. 1902, p. 213; Ybk. 1899, p. 290; India, Bul. 1, p. 303.
 Methods of destroying, F. Bul. 383, pp. 6–11; Rept. 1887, pp. 423–426; Rept. 1899, p. 66.
 Other notes, Rept. 1887, pp. 400–401, 424–426; Rept. 1891, p. 271; Rept. 1899, p. 66; Rept. 1907, pp. 493, 500–501; Rept. 1908, pp. 577–578, 586–587; Rept. 1909, pp. 539–540; Ybk. 1895, p. 418.
 Reference to studies of food habits, Ybk. 1899, pp. 264–265, 266, 291.
 Repressive measures employed in California, Rept. 1908, pp. 577–578, 586–587; Rept. 1909, pp. 539–540.
 Request for information on economic relations, Ent. Circ. 20 [p. 2]; Circ. 2 [p. 1]; Rept. 1886, p. 231; Schedule 4 [1].
 Sparrow hunts, Ybk. 1896, p. 67.
- Passer hispaniolensis*—Spanish sparrow.
 Injurious in Algeria, Bul. 1, p. 302.
- Passer indicus*, see *Passer domesticus* (Injurious in India).
- Passer montanus*—Tree sparrow.
 Economic status and introduction, Bul. 1, pp. 191–194; Ybk. 1899, pp. 287–288.
- Passerculus princeps*—Ipswich sparrow.
 Formal report, Bul. 15, p. 59 (56 stomachs).
- Passerculus sandwichensis*—Savanna sparrow.
 Brief account, Bul. 38, p. 62.
 Feeding on boll weevil, Bul. 22, pp. 11, 16; Bul. 25, pp. 9, 21; Bul. 29, pp. 6, 19, 27, 28, 30; Bul. 38, pp. 9, 62; Circ. 64, pp. 3, 4, 5.
 Food at Marshall Hall, Bul. 17, pp. 15, 30, 32, 35, 38, 71, 73.
 Formal report, Bul. 15, pp. 37, 59–61, 90 (119 stomachs).
 Insectivorous, Bul. 1, p. 323.
- Passerella iliaca*—Fox sparrow.
 Feeding on boll weevil, Circ. 64, pp. 3, 5; weed seeds, Bul. 15, p. 27; F. Bul. 54, p. 28; F. Bul. 54 (rev.), p. 32; Ybk. 1898, pp. 222, 226, 227.

Passerella iliaca—Continued.

Food at Marshall Hall, Bul. 17, pp. 16, 77.

Formal report, Bul. 15, pp. 27, 28, 37, 42, 43, 74, 83, 87-89 (127 stomachs).

Passerherbulus caudacutus—Sharp-tailed sparrow.

Formal report, Bul. 15, pp. 64-65.

Passerherbulus henslowi—Henslow's sparrow.

Food at Marshall Hall, Bul. 17, pp. 32, 35, 38, 39.

Formal report, Bul. 15, pp. 24, 63-64 (7 stomachs).

Passerherbulus maritimus—Seaside sparrow.

Formal report, Bul. 15, pp. 65-66 (30 stomachs).

Passerherbulus nelsoni—Nelson's sparrow.

Formal report, Bul. 15, pp. 64-65.

Passerina ciris—Painted bunting.

Feeding on boll weevil, Bul. 25, pp. 9, 12, 17, 18, 20-21; Bul. 29, pp. 6, 9, 19, 30; Bul. 38, p. 9; Circ. 64, p. 5.

Passerina cyanea—Indigo bunting.

Brief account, Bul. 38, pp. 9, 68.

Food at Marshall Hall, Bul. 17, p. 98.

Passerina nivalis, see *Plectrophenax nivalis*.*Pediocetes phasianellus*—Sharp-tailed grouse.

Favorite vegetable foods, Ybk. 1909, p. 194.

Feeding on ants, barley, beetles, Fauna 27, p. 350; berries of *Viburnum pauciflorum*, catkins of alders (*Alnus alnobetula* and *A. incana*), Fauna 27, p. 349; leaves, myriapods, Fauna 27, p. 350; potato beetle, Bul. 32, p. 47.

Formal report, Bul. 24, pp. 20-23 (43 stomachs).

Peep, see *Ereunetes pusillus*.*Pelecanus fuscus*, see *Pelecanus occidentalis*.*Pelecanus occidentalis*—Brown pelican.

Food of nestlings, Ybk. 1900, pp. 434-435.

Pelican, Brown, see *Pelecanus occidentalis*.*Pelidna alpina sakhalina*—Red-backed sand-piper.

Feeding on Dytiscidae, *Nereis*, Circ. 79, p. 8.

Penthestes atricapillus—Black-capped chickadee.

Beneficial, Ybk. 1897, p. 670.

Brief account, F. Bul. 54 (rev.), pp. 43-44 (289 stomachs); Ybk. 1900, pp. 295-296.

Feeding on eggs of fall cankerworms, Bul. 17, p. 108; larvae of codling moth (probably), Ybk. 1898, p. 105; plant lice, Bul. 17, p. 108; scale insects, Ybk. 1906, p. 197.

Penthestes atricapillus—Continued.

Reference to studies of food habits, Ybk. 1899, pp. 263-264.

Relations to orchards, Ybk. 1900, pp. 295-296.

Penthestes carolinensis—Carolina chickadee.

Brief account, Bul. 38, p. 89.

Feeding on boll weevil, Circ. 64, pp. 4, 5; scale insects, Ybk. 1906, p. 197; seeds of ragweed, Bul. 15, p. 42.

Food at Marshall Hall, Bul. 17, pp. 20, 23, 24, 34, 35, 39, 60, 71, 77, 107-108 (7 stomachs).

Other notes, F. Bul. 54 (rev.), p. 44.

Penthestes gambeli—Mountain chickadee.

General nature of food, Bul. 30, p. 71.

Penthestes rufescens—Chestnut-backed chickadee.

Feeding on scale insects, Ybk. 1906, p. 194.

Food in California, Bul. 30, pp. 70-71 (57 stomachs).

Perdix perdix—European common partridge.

Brief account, Ybk. 1909, p. 252.

Perisoreus canadensis—Canada jay.

Feeding on carrion, Fauna 30, p. 89; crowberries (*Empetrum nigrum*), Fauna 27, p. 401; refuse and scraps of meat about camp, Fauna 24, p. 71; Fauna 30, pp. 40, 62.

Other notes, Fauna 5, p. 18; Fauna 30, p. 89.

Useful as scavengers, Fauna 30, p. 61.

Petrel, Black, see *Oceanodroma melania*.*Petrochelidon lunifrons*—Cliff swallow.

Beneficial, Bul. 1, p. 89.

Brief account, Bul. 38, p. 70; F. Bul. 54, p. 31; F. Bul. 54 (rev.), pp. 36-38.

Feeding on boll weevil, Bul. 29, pp. 6, 12-13, 24-25, 30; Bul. 38, p. 70; Circ. 64, p. 5.

Food in California, Bul. 30, pp. 28-30 (123 stomachs).

Protection urged, as enemy of boll weevil, Circ. 56, pp. 1, 2, 3, 4; Circ. 57, pp. 1, 2.

Relation to bedbugs, Bul. 29, pp. 8, 13; Circ. 56, p. 2; Circ. 57, p. 2; bees, Rept. 1904, p. 294.

Pewee, Western wood, see *Myiochanes richardsoni*.

Wood, see *Myiochanes virens*.

Phainopepla nitens—Phainopepla.

Damage to fruit, Bul. 32, p. 61.

Feeding on insects, mistletoe berries, Fauna 7, p. 113.

Phalacrocorax auritus—Double-crested cormorant.

Feeding on fish, Bul. 38, p. 16.

Phalacrocorax urile—Red-faced cormorant.

Food of nestlings, Ybk. 1900, p. 434.

Phalarope, Northern, see *Lobipes lobatus*.

Willson's, see *Steganopus tricolor*.

- Phalaropus lobatus*, see *Lobipes lobatus*.
Phalaris psittacula—Paroquet auklet.
 Food of nestlings, Ybk. 1900, p. 433.
Phasianus colchicus—Common pheasant.
 Feeding on galls, Bul. 24, p. 31.
Phasianus torquatus—Ring-necked pheasant.
 Damage to gardens and grain, Rept. 1888, pp. 486, 487, 488; Ybk. 1897, pp. 352-353.
 Food of young in captivity, Ybk. 1900, p. 432.
 Pheasant, Common, see *Phasianus colchicus*.
 English, see *Phasianus colchicus*.
 Ring-necked, see *Phasianus torquatus*.
Philohela minor—Woodcock.
 Brief account, Ybk. 1900, p. 432; Ybk. 1901, p. 449.
 Feeding on click beetles, Circ. 79, p. 6; crane flies, Circ. 79, p. 4; cutworms, Circ. 79, p. 6; grasshoppers, Circ. 79, p. 4; wireworms, Circ. 79, p. 6.
 Food at Marshall Hall, Bul. 17, pp. 19, 21, 24, 38, 82-83.
 Food of nestlings, Ybk. 1900, p. 432.
Phloeotomus pileatus—Pileated woodpecker.
 Brief account, Bul. 38, p. 48.
 Distributing poison Rhus seeds, Rept. 1890, p. 283.
 Formal report, Bul. 7, pp. 8, 10, 11, 32, 38, 39 (23 stomachs); Bul. 37, pp. 10, 33-35 (80 stomachs).
 Relation to trees, Bul. 39, p. 8.
Phœbe, see *Sayornis phœbe*.
 Black, see *Sayornis nigricans*.
 Say's, see *Sayornis sayus*.
Pica pica hudsonia—Magpie.
 Feeding on carrion, Fauna 5, p. 99; field mice (*Microtus montanus*), F. Bul. 335, p. 12.
 Killed by eating poisoned grain, F. Bul. 352, p. 8; Ybk. 1908, p. 308.
 Other notes, Fauna 5, p. 18; Fauna 19, p. 80.
Picicorvus columbianus, see *Nucifraga columbiana*.
Picoides americanus—Three-toed woodpecker.
 Brief account, Bul. 7, p. 33.
 Formal report, Bul. 37, pp. 10, 11, 25-27 (23 stomachs).
Picoides arcticus—Arctic three-toed woodpecker.
 Brief account, Bul. 7, p. 33.
 Feeding on scale insects, Ybk. 1906, p. 197.
 Formal report, Bul. 37, pp. 10, 11, 25-27 (28 stomachs).
 Pigeon, Band-tailed, see *Columba fasciata*.
 Common, see *Columba livia*.
 Passenger, see *Ectopistes migratorius*.
 Tres Marias, see *Columba flavirostris madrensis*.
 Pigeon, Wild, see *Ectopistes migratorius*.
 Wood, see *Columba palumbus*.
Pinicola enucleator alascensis—Alaska pine grosbeak.
 Feeding on seeds of alder (*Alnus alnobetula*), Fauna 27, p. 415; dwarf birch (*Betula nana*), Fauna 27, p. 414.
Pinicola enucleator leucura—Pine grosbeak.
 Brief account, Bul. 32, p. 5.
 Pintail, see *Dafla acuta*.
Pipilo crissalis—California towhee.
 Feeding on scale insects, Ybk. 1906, p. 194; weed seeds, Ybk. 1898, p. 230.
 Food in California, Bul. 34, pp. 89-93 (399 stomachs).
Pipilo erythrophthalmus—Towhee.
 Brief account, Bul. 38, p. 67.
 Feeding on boll weevil, Bul. 29, pp. 6, 20, 28, 30; Circ. 64, p. 5; weed seeds, Ybk. 1898, p. 230.
 Food at Marshall Hall, Bul. 17, pp. 30, 34, 35, 38, 98.
 Food of nestlings, Ybk. 1900, p. 418.
Pipilo maculatus megalonyx—Spurred towhee.
 Feeding on scale insects, Ybk. 1906, p. 194.
Pipilo maculatus subspecies—Spotted towhees.
 Food in California, Bul. 34, pp. 86-89 (139 stomachs).
 Pipit, see *Anthus rubescens*.
Piranga bidentata flammea—Tres Marias tanager.
 Feeding on wild fig, Fauna 14, p. 61.
Piranga erythromelas—Scarlet tanager.
 Brief account, Bul. 38, p. 69; Ybk. 1900, pp. 418-419.
 Feeding on mulberries, Rept. 1890; p. 285; potato beetle, Bul. 32, p. 47.
 Food at Marshall Hall, Bul. 17, pp. 20, 29, 30, 39, 40, 98.
 Food of nestlings, Ybk. 1900, pp. 418-419.
Piranga ludoviciana—Western tanager.
 Damage to fruit, Bul. 32, p. 61.
 Feeding on beetle, Fauna 7, p. 108; caterpillars, Fauna 16, p. 127.
 Food in California, Bul. 30, pp. 9, 23-26 (46 stomachs).
 Other notes, Fauna 14, p. 52.
 Relation to fruit in California, Ybk. 1904, p. 242.
Piranga rubra—Summer tanager.
 Brief account, Bul. 38, p. 70.
 Food at Marshall Hall, Bul. 17, pp. 40, 60, 61, 98.
Pisobia bairdi—Baird's sandpiper.
 Feeding on clover root curculio, Circ. 79, p. 6; crane flies, Circ. 79, p. 4; cutworms, Circ. 79, p. 6; grasshoppers, Circ. 79, p. 4; mosquitoes, Circ. 79, p. 2.

- Pisobia fuscicollis* — White-rumped sandpiper.
Feeding on clover root curculio, *Circ.* 79, p. 6; grasshoppers, *Circ.* 79, p. 4.
- Pisobia maculata*—Pectoral sandpiper.
Feeding on bill-bugs, click beetles, clover root curculio, corn-leaf beetle, *Circ.* 79, p. 6; crane flies, *Circ.* 79, p. 2; cutworms, *Circ.* 79, p. 6; *Dytiscidae*, *Circ.* 79, p. 8; horseflies, *Circ.* 79, p. 4; mosquitoes, *Circ.* 79, p. 2; wireworms, *Circ.* 79, p. 6.
- Pisobia minutilla*—Least sandpiper.
Feeding on grasshoppers, *Circ.* 79, p. 4; mosquitoes, *Circ.* 79, p. 2.
- Planesticus graysoni*—Tres Marias robin.
Feeding on wild fig, *Fauna* 14, p. 61.
- Planesticus migratorius*—Robin.
Beneficial, *Ybk.* 1897, p. 670.
Brief account, *Bul.* 12, p. 23; *Bul.* 12 (rev.), pp. 29–30; *Bul.* 38, p. 92; *F. Bul.* 54, pp. 37–38 (330 stomachs); *F. Bul.* 54 (rev.), pp. 44–46 (500 stomachs); *Ybk.* 1900, pp. 303, 304, 413; *Ybk.* 1907, pp. 168–169, 175, 178.
Damage to fruit, *Bul.* 30, pp. 11, 20; *Rept.* 1901, p. 153; *Ybk.* 1904, pp. 243, 244, 252–253; *Ybk.* 1907, pp. 168–169, 175, 178; grapes, *Bul.* 1, pp. 53, 270, 324.
Feeding on buffalo berries, *Fauna* 7, p. 147, cankerworm moths, *Bul.* 1, p. 110; cherries, *Bul.* 1, p. 60; *Bul.* 32, p. 91; crowberries, *Fauna* 27, p. 497; cutworms, *Bul.* 1, p. 286; earthworms, *Bul.* 1, pp. 86, 94, 264, 275, 297, 305; *Ybk.* 1895, p. 411; gipsy moth, *Rept.* 1910, p. 553; mulberries, *Bul.* 32, p. 65; *Rept.* 1890, p. 285; peaches, pears, *Bul.* 1, p. 270; peas, *Bul.* 1, p. 60; potato beetle, *Bul.* 32, p. 47; tussock moth caterpillar, *Bul.* 1, pp. 108, 109, 324; *Rept.* 1886, p. 244; snowberry (probably), wild grape, *Bul.* 2, p. 290.
Food at Marshall Hall, *Bul.* 17, pp. 14, 32, 35, 37, 38, 43, 59, 62, 108–109 (9 stomachs).
Food in California, *Bul.* 30, pp. 9, 20, 23, 93–97 (74 stomachs).
Food of nestlings, *Ybk.* 1900, pp. 411, 413, 436.
Insectivorous, *Bul.* 12, p. 14; *Bul.* 12 (rev.), p. 22; *Bul.* 38, p. 9.
Other notes, *Bul.* 1, pp. 126, 304; *Bul.* 30, pp. 11, 20, 94; *Ybk.* 1908, p. 346.
Reference to studies of food habits, *Ybk.* 1899, pp. 261–262, 263, 264, 266.
Relation to fruit in California, *Bul.* 30, p. 20, *Rept.* 1901, p. 153; *Ybk.* 1904, pp. 243, 252–253.
- Planesticus migratorius*—Continued.
Relation to orchards, *Ybk.* 1900, pp. 303, 304; *Ybk.* 1907, pp. 168–169, 175–178.
Request for information on economic relations, *Ent. Circ.* 20 [p. 2].
Robbed of food by English sparrow, *Bul.* 1, pp. 86, 94, 264, 275, 286, 297, 305.
Plectrophenax nivalis—Snow bunting.
Feeding on seeds of grasses, *Fauna* 27, p. 421; and weeds, *Fauna* 27, p. 421; *Ybk.* 1898, pp. 222, 226, 227.
Formal report, *Bul.* 15, pp. 25, 27, 28, 45, 51–54 (46 stomachs).
Pulling wheat, *Bul.* 23, p. 16.
- Plover, Black-bellied, see *Squatarola squatarola*.
Golden, see *Charadrius dominicus*.
Mountain, see *Podasocys montanus*.
Piping, see *Ægialitis meloda*.
Ringed, see *Ægialitis hiaticula*.
Semipalmated, see *Ægialitis semipalmata*.
Snowy, see *Ægialitis nivosa*.
Upland, see *Bartramia longicauda*.
- Podasocys montanus*—Mountain plover.
Feeding on grasshoppers, *Circ.* 79, p. 2.
- Podilymbus podiceps*—Pied-billed grebe.
Food at Marshall Hall, *Bul.* 17, p. 79.
Harmless, *Bul.* 38, p. 14.
- Pœcile palustris*—Marsh titmouse.
Feeding on scale insects, *Ybk.* 1906, p. 191.
- Polioptila cærulea*—Blue-gray gnatcatcher.
Brief account, *Bul.* 38, p. 90.
Food at Marshall Hall, *Bul.* 17, pp. 24, 34, 108.
Food in California, *Bul.* 30, pp. 84–86 (30 stomachs).
- Polioptila californica*—Black-tailed gnatcatcher.
Feeding on scale insects, *Ybk.* 1906, pp. 194, 198.
Food in California, *Bul.* 30, pp. 84–86 (30 stomachs).
- Polyborus cheriway*—Caracara.
Beneficial, *Circ.* 61, p. 3; *Ybk.* 1894, p. 217; *Ybk.* 1895, p. 590; *Ybk.* 1896, p. 628.
Brief account, *Bul.* 3, pp. 11, 128–129.
Feeding on carrion, *Bul.* 2, p. 120; jack rabbits, *Bul.* 8, p. 44; prairie dogs, *Bul.* 2, p. 120.
Food on Tres Marias Islands, carrion, iguanas, *Fauna* 14, p. 39; and *Lepus graysoni*, *Fauna* 14, p. 17.
- Polyborus tharus*—Carancho.
Attempting to carry off wounded duck, *Bul.* 3, p. 128.
- Poœcetes gramineus*—Vesper sparrow.
Feeding on boll weevil, *Circ.* 64, pp. 3, 5; weed seeds, *Ybk.* 1898, pp. 226, 227, 229.
Food at Marshall Hall, *Bul.* 17, p. 15.

- Poecetes gramineus*—Continued.
Formal report, Bul. 15, pp. 28, 37, 45, 56-58, 92 (130 stomachs).
- Porzana carolina*—Sora.
Food at Marshall Hall, Bul. 17, pp. 19, 81.
- Prairie chicken, see *Tympanuchus americanus*.
Lesser, see *Tympanuchus pallidicinctus*.
- Progne subis*—Purple martin.
Brief account, Bul. 38, p. 70; Bul. 30, p. 27; F. Bul. 54, p. 31; F. Bul. 54 (rev.), pp. 5, 36-38.
Feeding on boll weevil, Bul. 29, pp. 6, 9, 14, 25, 30; Bul. 38, p. 70; Circ. 64, p. 5.
Food at Marshall Hall, Bul. 17, pp. 20, 24, 25, 39, 40, 47, 98-99.
Food of nestlings, Ybk. 1900, p. 417.
Insectivorous, Bul. 38, p. 9; Bul. 1, p. 96.
Nesting boxes, Bul. 29, pp. 9-11.
Other notes, Bul. 1, p. 274.
Prepared food, Circ. 56, p. 3.
Protection urged, as enemy of boll weevil, Circ. 56, pp. 1, 3-4; Circ. 57, pp. 2, 3, 4.
- Protonotaria citrea*—Prothonotary warbler.
Insectivorous, Bul. 38, p. 75.
- Psaltiriparus minimus*—Bushtit.
Brief account, F. Bul. 54 (rev.), p. 44 (66 stomachs); Ybk. 1900, p. 296.
Feeding on noxious insects, Ybk. 1904, p. 253; scale insects, Ybk. 1906, pp. 194, 195, 198.
Food in California, Bul. 30, pp. 74-80 (353 stomachs).
Relation to orchards, Ybk. 1900, p. 296.
- Pseudogryphus californianus*, see *Gymnogyps californianus*.
- Psittacula insularis*—Tres Marias love bird.
Feeding on wild fig, Fauna 14, pp. 41, 61.
- Ptarmigan*, Rock, see *Lagopus rupestris*.
White-tailed, see *Lagopus leucurus*.
Willow, see *Lagopus lagopus*.
- Puffin, Horned, see *Fratercula corniculata*.
Tufted, see *Lunda cirrhata*.
- Pyrrhuloxia sinuata*—Gray grosbeak.
Brief account, F. Bul. 456, p. 12.
Feeding on boll weevil, Bul. 25, pp. 9, 12, 18, 21; Bul. 29, pp. 6, 19, 30; Circ. 64, p. 5.
Formal report, Bul. 32, pp. 28-33, 90, 91 (74 stomachs).
- Q.
- Quail, California, see *Lophortyx californica*.
Gambel's, see *Lophortyx gambeli*.
Mearns's, see *Cyrtonyx montezumae mearnsi*.
Mountain, see *Oreortyx picta*.
Scaled, see *Callipepla squamata*.
- Querquedula discors*—Blue-winged teal.
Brief account, Bul. 38, p. 19.
Vegetable food, Circ. 81, p. 1.
- Quiscalus major*, see *Megaquiscalus major*.
Quiscalus quiscula—Crow blackbird.
Brief account, Bul. 38, p. 60; F. Bul. 54, pp. 4, 24-26 (2,258 stomachs); F. Bul. 54 (rev.), pp. 4, 25, 29-30 (2,346 stomachs); Rept. 1887, pp. 428, 429, 430; Rept. 1890, p. 279; Ybk. 1897, pp. 348-349; Ybk. 1900, pp. 412, 423.
Damage to corn, Bul. 17, p. 96; Bul. 29, p. 8; grain, Rept. 1887, pp. 428, 429, 430; Rept. 1889, pp. 368-369; Rept. 1898, p. 39; Ybk. 1897, pp. 348-349; Ybk. 1898, p. 230.
Feeding on boll weevil, Bul. 29, pp. 6, 7, 8, 11, 17, 27, 30; Bul. 38, p. 60; Circ. 64, p. 5; eggs and young of other birds, Rept. 1888, p. 514; English sparrows, Bul. 1, p. 32; mulberries, Rept. 1890, p. 285; rose beetle, Bul. 32, p. 20; weed seeds, Ybk. 1898, pp. 222, 230.
Food at Marshall Hall, Bul. 17, pp. 14, 21, 23, 24, 30, 32, 35, 37, 47-48, 49, 55, 56, 59, 60, 66-68, 70, 71, 77, 96, 110 (25 stomachs).
Food of nestlings, Ybk. 1900, pp. 412-413, 423-424, 436.
Formal report, Bul. 13, pp. 8, 9, 10, 53-70 (2,346 stomachs); Ybk. 1894, pp. 233-248 (2,258 stomachs).
Injurious to grain, hence unprotected in certain States, Bul. 12, pp. 36, 37; Bul. 12 (rev.), p. 43.
Other notes, Bul. 15, p. 29; Ybk. 1898, p. 104.
Reference to studies of food habits, Ybk. 1899, pp. 263, 264, 265, 266.
Requests for information on economic value, Ent. Circ. 20 [p. 1]; Circ. 1 [p. 2]; Rept. 1886, p. 230.
- R.
- Raven, Northern, see *Corvus corax principalis*.
Old-world, see *Corvus corax corax*.
Southern, see *Corvus corax sinuatus*.
White-necked, see *Corvus cryptoleucus*.
- Recurvirostra americana*—Avocet.
Feeding on billbugs, cutworms, Circ. 79, p. 6; Dytiscidae, Circ. 79, p. 8; grasshoppers, Circ. 79, p. 4.
- Redbird, see *Cardinalis cardinalis*.
Redhead, see *Marila americana*.
Redpoll, see *Acanthis linaria*.
Hoary, see *Acanthis hornemanni exilis*.
- Redstart, see *Setophaga ruticilla*.
Regulus calendula—Ruby-crowned kinglet.
Feeding on scale insects, Ybk. 1906, pp. 197, 198.

Regulus calendula—Continued.

Food at Marshall Hall, Bul. 17, pp. 20, 108.

Food in California, Bul. 30, pp. 48, 81-84 (294 stomachs).

Other notes, Ybk. 1904, p. 254.

Regulus satrapa—Golden-crowned kinglet.

Food at Marshall Hall, Bul. 17, pp. 20, 108.

Food in California, Bul. 30, p. 84 (9 stomachs).

Other notes, Bul. 9, p. 18; Ybk. 1904, p. 254.

Rhynchophanes mccowni—McCown's longspur.

Feeding on weed seeds, Ybk. 1898, p. 226.

Ricebird [American], see *Dolichonyx oryzivorus*.

[Javan], see *Padda oryzivora*.

Ringneck, see *Ægialitis semipalmata*.

Riparia riparia—Bank swallow.

Brief account, Bul. 38, p. 71; Ybk. 1900, p. 418.

Feeding on ants, Bul. 15, p. 32; bayberries, Rept. 1890, p. 282; boll weevil, Bul. 29, pp. 6, 14, 24, 25, 30; Bul. 38, p. 71; Circ. 56, pp. 1-2; Circ. 57, p. 2; Circ. 64, p. 5.

Food at Marshall Hall, Bul. 17, pp. 24, 25, 33, 34, 35, 36, 39, 40, 46-47, 98-99 (6 stomachs).

Food of nestlings, Ybk. 1900, p. 418.

Other notes, Bul. 30, p. 27.

Protection urged as enemy of boll weevil, Circ. 56, pp. 1-2; Circ. 57, p. 2.

Rissa tridactyla pollicaris—Pacific kittiwake.

Food of nestlings, Ybk. 1900, pp. 433-434.

Road runner, see *Geococcyx californianus*.

Robin [of the United States], see *Planesticus migratorius*.

Tres Marias, see *Planesticus graysoni*.

Rook, see *Corvus frugilegus*.

Rostrhamus sociabilis—Everglade kite.

Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 3, pp. 11, 25-26; Circ. 61, pp. 3, 4; Ybk. 1894, pp. 217, 218.

S.

Sage hen, see *Centrocercus urophasianus*.

Salpinctes obsoletus—Rock wren.

Note on general nature of food, Bul. 30, pp. 65-66.

Sandpiper, Baird's, see *Pisobia bairdi*.

Buff-breasted, see *Tryngites subruficollis*.

Least, see *Pisobia minutilla*.

Pectoral, see *Pisobia maculata*.

Purple, see *Arquatella maritima*.

Red-backed, see *Pelidna alpina sakhalina*.

Sandpiper, Semipalmated, see *Ereunetes pusillus*.

Solitary, see *Helodromas solitarius*.

Spotted, see *Actitis macularia*.

Stilt, see *Micropalama himantopus*.

White-rumped, see *Pisobia fuscicollis*.

Sapsucker, Red-breasted, see *Sphyrapicus ruber*.

Williamson's, see *Sphyrapicus thyroideus*.

Yellow-bellied, see *Sphyrapicus varius*.

Sayornis nigricans—Black phoebe.

Brief account, F. Bul. 54 (rev.), pp. 17-18 (119 stomachs).

Food in California, Bul. 34, pp. 36-39 (333 stomachs).

Sayornis phoebe—Phebe.

Brief account, Bul. 38, p. 53; F. Bul. 54, pp. 13-14 (80 stomachs); F. Bul. 54 (rev.), pp. 16-17 (156 stomachs); Ybk. 1900, p. 426.

Feeding on boll weevil, Bul. 22, pp. 10, 16; Bul. 25, pp. 8, 13, 21; Bul. 29, pp. 6, 15, 26, 30; Bul. 38, p. 53; Circ. 64, p. 5; mulberries, Rept. 1890, p. 285; rose beetle, Bul. 32, p. 20.

Food at Marshall Hall, Bul. 17, pp. 23, 24, 30, 32, 33, 34, 37, 38, 40, 61, 92-93.

Food of nestlings, Ybk. 1900, pp. 426-427.

Sayornis sayus—Say's phoebe.

Food in California, Bul. 34, pp. 35-36 (86 stomachs).

Scolecophagus carolinus, see *Euphagus carolinus*.

Scolecophagus cyanocephalus, see *Euphagus cyanocephalus*.

Scoter, see *Oldemia americana*.

White-winged, see *Oldemia deglandi*.

Scotlaptex cinerea, see *Scotlaptex nebulosa*.

Scotlaptex nebulosa—Great gray owl.

Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Feeding on field mice, Bul. 31, p. 50; Ybk. 1905, p. 371; rabbits, Fauna 27, p. 369; shrews, Fauna 27, p. 370.

Formal report, Bul. 3, pp. 11, 157-158 (9 stomachs).

Selurus aurocapillus—Ovenbird.

Food at Marshall Hall, Bul. 17, pp. 20, 29, 34, 35, 103-104.

Food of nestlings, Ybk. 1900, p. 416.

Selurus motacilla—Louisiana water-thrush.

Food at Marshall Hall, Bul. 17, pp. 20, 38, 40, 103-104.

Seiurus noveboracensis—Water-thrush.

Food at Marshall Hall, Bul. 17, pp. 20, 24, 34, 35, 38, 39, 103-104.

Setophaga ruticilla—Redstart.

Brief account, Bul. 38, p. 83.

Food at Marshall Hall, Bul. 17, pp. 20, 23, 24, 29, 40, 103-104 (5 stomachs).

Food of nestlings, Ybk. 1900, p. 416.

Shoveler, see *Spatula clypeata*.

Shrike, Great gray, see *Lanius excubitor*.
Loggerhead, see *Lanius ludovicianus*.

Northern, see *Lanius borealis*.

Sialia arctica, see *Sialia currucoides*.

Sialia currucoides—Mountain bluebird.

Brief account, F. Bul. 54, p. 48.

Other notes, Bul. 30, p. 100.

Sialia mexicana occidentalis—Western bluebird.

Brief account, F. Bul. 54 (rev.), p. 48 (92 stomachs).

Feeding on scale insects, Ybk. 1906, pp. 194, 198.

Food in California, Bul. 30, pp. 97-100 (187 stomachs).

Sialia sialis—Bluebird.

Beneficial, Ybk. 1897, p. 670.

Brief account, Bul. 38, p. 92; F. Bul. 54, p. 39 (205 stomachs); F. Bul. 54 (rev.), pp. 5, 46-48 (300 stomachs); Ybk. 1900, p. 413.

Distributing poison *Rhus* seeds, Rept. 1889, p. 368; Rept. 1890, p. 283.

Feeding on army worm, Bul. 1, p. 290; codling moth, Bul. 1, p. 320; cutworms, Bul. 1, p. 290; dogwood berries, Rept. 1890, p. 284; mahaleb cherries, Bul. 32, p. 65; mulberries, Bul. 32, p. 64; sorgum berries, Rept. 1890, p. 285.

Food at Marshall Hall, Bul. 17, pp. 32, 38, 43, 60, 62, 109-110 (7 stomachs).

Food of nestlings, Ybk. 1900, p. 413.

Insectivorous, Bul. 38, p. 9; Bul. 1, pp. 96, 126, 304.

Other notes, Bul. 1, pp. 94, 297.

Reference to studies of food habits, Ybk. 1899, pp. 263, 266.

Siskin, Pine, see *Spinus pinus*.

Sitta canadensis—Red-breasted nuthatch.

General nature of food, Bul. 30, p. 68.

Relation to orchards, Ybk. 1900, pp. 296-297.

Sitta carolinensis—White-breasted nuthatch.

Brief account, Bul. 17, p. 107; Bul. 38, p. 88.

Feeding on scale insects, Ybk. 1906, pp. 194, 197.

General nature of food, Bul. 30, p. 68.

Relation to orchards, Ybk. 1900, pp. 296-297.

Sitta pygmaea—Pygmy nuthatch.

Food in California, Bul. 30, pp. 67-68 (31 stomachs).

Skylark, see *Alauda arvensis*.

Snakebird, see *Anhinga anhinga*.

Snipe, Wilson's, see *Gallinago delicata*.

Snowbird, see *Junco hyemalis*.

Solitaire, see *Myadestes townsendi*.

Sora, see *Porzana carolina*.

Sparrow, Chipping, see *Spizella passerina*.

English, see *Passer domesticus*.

Field, see *Spizella pusilla*.

Fox, see *Passerella illaca*.

Golden-crowned, see *Zonotrichia coronata*.

Grasshopper, see *Ammodramus savannarum australis*.

Harris's, see *Zonotrichia querula*.

Henslow's, see *Passerherbulus henslowi*.

House, see *Passer domesticus*.

Ipswich, see *Passerculus princeps*.

Java, see *Padda oryzivora*.

Lark, see *Chondestes grammacus*.

Lincoln's, see *Melospiza lincolni*.

Nelson's, see *Passerherbulus nelsoni*.

Savanna, see *Passerculus sandwichensis*.

Seaside, see *Passerherbulus maritimus*.

Sharp-tailed, see *Passerherbulus caudacutus*.

Song, see *Melospiza melodia*.

Swamp, see *Melospiza georgiana*.

Spanish, see *Passer hispaniolensis*.

Tree [American], see *Spizella monticola*.

Tree [Old World], see *Passer montanus*.

Vesper, see *Poecetes gramineus*.

White-crowned, see *Zonotrichia leucophrys*.

White-throated, see *Zonotrichia albicollis*.

Spatula clypeata—Shoveler.

Brief account, Bul. 38, p. 19.

Feeding on larvæ and pupæ of *Ephydra hians*, Fauna 7, p. 17.

Vegetable food, Circ. 81, p. 1.

Speotyto cunicularia floridana—Florida burrowing owl.

Food of adults and nestlings, Ybk. 1900, p. 431.

Speotyto cunicularia hypogæa—Burrowing owl.

Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628.

Brief account, Bul. 31, p. 50; Circ. 61, pp. 3, 12, 13; Ybk. 1894, pp. 217, 225, 227.

Feeding on beetles, Bul. 4, p. 15; grasshoppers, Bul. 4, p. 15; Fauna 7, p. 44; horned larks, Bul. 2, p. 124; Bul. 23, p. 12; insects, Fauna 5, p. 97; Rept. 1889, p. 373; mice, Bul. 2, p. 124; pocket mice (*Perognathus hispidus paradoxus*), Fauna

Speotyto cunicularia hypogaea—Continued.

25, p. 137; scorpions, Fauna 5, p. 97; spermophiles, Bul. 4, pp. 15-16.

Formal report, Bul. 3, pp. 11, 14, 165, 189-196 (32 stomachs); Rept. 1887, p. 422 (10 stomachs).

Sphyrapicus ruber—Red-breasted sapsucker.

Brief account, Bul. 39, pp. 95-96.

Food in California, Bul. 34, pp. 21-22, 29 (24 stomachs).

Formal report, Bul. 37, pp. 10, 11, 31-32 (34 stomachs).

Other notes, Bul. 34, p. 8.

Relation to trees, Bul. 39, pp. 16-21, 50-53, 54-62, 86, 98-99.

Sphyrapicus thyroideus—Williamson's sapsucker.

Brief account, Bul. 39, pp. 95-96.

Formal report, Bul. 37, pp. 10, 11, 32-33 (17 stomachs).

Relation to trees, Bul. 39, pp. 9, 16-21, 53, 54-62, 66, 98-99.

Sphyrapicus varius—Yellow-bellied sapsucker.

Brief account, Bul. 38, p. 47; Bul. 39, pp. 95-96; F. Bul. 54, pp. 9, 10; F. Bul. 54 (rev.), pp. 12-13; Ybk. 1900, pp. 294-295.

Feeding on fruits of cherry, flowering dogwood, grape, and sour gum, Rept. 1890, p. 284; scale insects, Ybk. 1906, p. 197.

Food at Marshall Hall, Bul. 17, pp. 19, 33, 62, 88-90, 110.

Food of nestlings, Ybk. 1900, pp. 427-428.

Formal report, Bul. 7, pp. 7, 8, 10, 11, 28-31, 38-39 (81 stomachs); Bul. 37, pp. 10, 11, 27-31, 42, (313 stomachs).

Injurious, Bul. 34, p. 21; Ybk. 1907, p. 168.

Reference to studies of food habits, Ybk. 1899, p. 266.

Relation to orchards, Ybk. 1900, pp. 294-295.

Relation to trees, Bul. 38, p. 47; Bul. 39, pp. 16-21, 21-50, 54-91, 92-95, 98-99.

Spinus pinus—Pine siskin.

Feeding on weed seeds, Fauna 7, p. 85; Ybk. 1898, pp. 222, 229.

Spiza americana—Dickcissel.

Brief account, Bul. 38, p. 69; Ybk. 1900, p. 420.

Feeding on boll weevil, Bul. 22, p. 16; Bul. 25, pp. 9, 12, 18, 21; Bul. 29, pp. 6, 19, 30; Circ. 64, p. 5; weed seeds, Ybk. 1898, pp. 226, 227, 228, 229.

Food of nestlings, Ybk. 1900, p. 420.

Formal report, Bul. 15, pp. 23, 24, 28, 45, 89-92 (152 stomachs).

Spizella monticola—Tree sparrow.

Beneficial, Ybk. 1897, p. 670.

Brief account, F. Bul. 54, p. 28; F. Bul. 54 (rev.), p. 32.

Feeding on seeds, Bul. 9, pp. 17, 20; of grapes, Fauna 3, p. 96; of weeds, Fauna 3, p. 96; Ybk. 1898, pp. 222, 225, 226, 227; Ybk. 1907, p. 172.

Food at Marshall Hall, Bul. 17, pp. 16, 71, 74-75 (9 stomachs).

Formal report, Bul. 15, pp. 18, 25, 27, 37, 38, 39, 42, 75-76 (517 stomachs).

Spizella passerina—Chipping sparrow.

Beneficial, Bul. 38, p. 9; Ybk. 1897, p. 670.

Brief account, Bul. 38, p. 65; F. Bul. 54, pp. 26-27; F. Bul. 54 (rev.), pp. 31-32.

Feeding on cankerworms, Bul. 1, p. 263; mulberries, Rept. 1890, p. 285; scale insects, Ybk. 1906, p. 194; weed seeds, Ybk. 1898, pp. 222, 223, 224, 225, 226, 227, 228.

Food at Marshall Hall, Bul. 17, pp. 15-16, 22, 25, 26, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 40, 43, 70, 71, 72-73, 97, 110 (61 stomachs).

Food in California, Bul. 34, pp. 80-82, 84 (96 stomachs).

Food of nestlings, Ybk. 1900, pp. 419-420.

Formal report, Bul. 15, pp. 15, 17, 18, 21, 23, 24, 26, 27, 28, 30, 32, 33, 76-78 (250 stomachs).

Other notes, Bul. 1, p. 93; Fauna 7, p. 119.

Reference to studies of food habits, Ybk. 1899, p. 264.

Spizella pusilla—Field sparrow.

Brief account, F. Bul. 54, pp. 26-27, 28; F. Bul. 54 (rev.), pp. 31-32.

Feeding on boll weevil, Bul. 29, pp. 6, 20, 28, 30; Circ. 64, pp. 3, 5; weed seeds, Ybk. 1898, pp. 222, 223, 225, 226, 228.

Food at Marshall Hall, Bul. 17, pp. 15-16, 24, 26, 27, 30, 32, 34, 35, 40, 41, 60, 70, 71, 72, 73, 74, 97 (31 stomachs).

Formal report, Bul. 15, pp. 15, 18, 21, 23, 24, 25, 26, 27, 28, 30, 33, 37, 39, 42, 78-80 (175 stomachs).

Spizella socialis, see *Spizella passerina*.*Squatarola squatarola*—Black-bellied plover.

Feeding on crowberries (*Empetrum*), Fauna 27, p. 332; grasshoppers, Circ. 79, p. 2.

Starling, see *Sturnus vulgaris*.*Steganopus tricolor*—Wilson's phalarope.

Feeding on billbugs, Circ. 79, p. 6; crane flies, Circ. 79, p. 4; Dytiscidae, Circ. 79, p. 8; mosquitoes, Circ. 79, p. 2.

- Stelgidopteryx serripennis*—Rough-winged swallow.
Food at Marshall Hall, Bul. 17, pp. 20, 24, 33, 34, 35, 39, 98-99 (7 stomachs).
Protection urged, Circ. 57, p. 2.
- Stercorarius parasiticus*—Parasitic jaeger.
Feeding on beetles, dragon fly, fish, insects, and young tern, Fauna 27, p. 261.
- Stercorarius pomarinus*—Pomarine jaeger.
Pursuing gulls and terns to rob them of their prey, Fauna 22, p. 78.
- Sterna fuliginosa*, see *Sterna fuscata*.
- Sterna fuscata*—Sooty tern.
Fishing habits described, Fauna 14, p. 25.
Food of nestlings, Ybk. 1900, p. 434.
- Sterna maxima*—Royal tern.
Food of nestlings, Ybk. 1900, p. 434.
- Sterna paradisæa*—Arctic tern.
Food of nestlings, Ybk. 1900, p. 434.
- Stilt, Black-necked, see *Himantopus mexicanus*.
Knudsen's, see *Himantopus knudseni*.
- Stork, Maguari, see *Euxenura maguari*.
White, see *Ciconia ciconia*.
- Strix aluco*, see *Aluco flammeus*.
- Strix occidentalis*—Spotted owl.
Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.
Brief account, Bul. 3, pp. 11, 156-157.
- Strix pratincola*, see *Aluco pratincola*.
- Strix varia*—Barred owl.
Beneficial, Ybk. 1895, p. 590; Ybk. 1896, p. 628; Ybk. 1897, p. 670.
Brief account, Bul. 31, pp. 48-49; Bul. 38, p. 42; Circ. 61, pp. 3, 11-12 (109 stomachs); Ybk. 1894, pp. 217, 225; Ybk. 1900, p. 430.
Feeding on Brewer's blackbird, cardinal, Bul. 2, p. 121; cotton rat (*Sigmodon hispidus texianus*), Fauna 25, p. 116; field mice, Bul. 31, pp. 48-49; Ybk. 1905, p. 371; Leconte's sparrow, Bul. 2, p. 121; rabbits, Ybk. 1907, p. 336; ruffed grouse, Bul. 24, p. 28.
Food of nestlings, Ybk. 1900, p. 430.
Formal report, Bul. 3, pp. 11, 14, 135, 146, 150-156 (109 stomachs); Rept. 1887, p. 419 (41 stomachs).
- Sturnella magna*—Meadowlark.
Beneficial, Rept. 1890, p. 280; Ybk. 1897, p. 670.
Bounty laws, Ybk. 1896, p. 57.
Brief account, Bul. 12, pp. 20-21; Bul. 12 (rev.), pp. 27-28; F. Bul. 54, pp. 21-23 (238 stomachs), F. Bul. 26-27 (285 stomachs); Rept. 1890, p. 280 (30 stomachs).
Exempt from protection in Georgia, Bul. 12 (rev.), p. 27.
- Sturnella magna*—Continued.
Feeding on boll weevil, Bul. 22, pp. 10, 16; Bul. 25, pp. 8, 9, 11, 21; Bul. 29, pp. 6, 9, 18, 27-28, 29, 30; Circ. 57, p. 4; Circ. 64, pp. 2, 3, 5; weed seeds, Bul. 15, pp. 37, 38-39; Ybk. 1898, pp. 222, 230-231.
Food at Marshall Hall, Bul. 17, pp. 12, 14, 22, 28, 30, 32, 34, 35, 37-38, 40, 70, 71, 77, 94-95, 110, 111 (7 stomachs).
Formal report, Ybk. 1895, pp. 419, 420-426 (238 stomachs).
Other notes, Ybk. 1904, p. 514; Ybk. 1908, p. 346.
Reference to studies of food habits, Ybk. 1899, p. 266.
Relation to clover seed, Rept. 1890, p. 280.
- Sturnella magna neglecta*, see *Sturnella neglecta*.
- Sturnella neglecta*—Western meadowlark.
Feeding on boll weevil, Bul. 22, pp. 9, 16; Bul. 25, pp. 8, 9, 11, 21; Bul. 29, pp. 6, 9, 18, 27-28, 30; Circ. 64, p. 5.
Food in California, Bul. 34, pp. 65-68 (91 stomachs).
Killed by eating poisoned grain, Bul. 23, p. 13; Circ. 76, p. 13; F. Bul. 352, p. 8; Ybk. 1908, p. 308.
Pulling wheat, Bul. 23, p. 15.
- Sturnus vulgaris*—Starling.
Admission denied, F. Bul. 470, p. 30; Rept. 1900, p. 41; Rept. 1904, p. 296; Rept. 1907, p. 493; Ybk. 1905, p. 545.
Admission to Western Australia prohibited, Rept. 1899, p. 68; Ybk. 1898, p. 109.
Driving other birds away, Bul. 1, p. 333.
Economic status, introduction dangerous, etc., Rept. 1899, p. 68; Rept. 1907, p. 493; Ybk. 1898, pp. 90, 101-103, 107, 109, 110.
Injurious, Circ. 34, p. 7; Circ. 80, p. 24; F. Bul. 160, p. 48; F. Bul. 180, p. 42; F. Bul. 470, p. 30; Rept. 1908, p. 587.
Injurious in Australasia, Rept. 1899, p. 68; Ybk. 1898, p. 109.
Other notes, Rept. 1899, p. 68; Rept. 1907, p. 493.
Repressive measures, Rept. 1908, p. 587.
- Sula nebouxi*—Blue-footed booby.
Feeding on fish, Fauna 14, pp. 23, 25, 32.
- Surnia ulula caparoch*—Hawk owl.
Beneficial, Circ. 61, p. 3; Ybk. 1894, p. 217; Ybk. 1895, p. 590; Ybk. 1896, p. 628.
Brief account, Bul. 3, pp. 187-189; Rept. 1887, p. 422.

Surnia ulula caparoch—Continued.

Feeding on field mice, Bul. 31, p. 50;
Ybk. 1905, p. 371; (*Microtus drum-*
mondi) Fauna 27, p. 377; redpolls;
ruffed grouse, Fauna 27, p. 377;
spermophiles, Bul. 4, pp. 15-16;
varying hare, Fauna 27, p. 376.

Swallow, Bank, see *Riparia riparia*.

Barn, see *Hirundo erythrogastra*.

Chiff, see *Petrochelidon lunifrons*.

European, see *Hirundo rustica*.

Northern violet-green, see *Tachycineta thalassina lepida*.

Rough-winged, see *Stelgidopteryx serripennis*.

Tree, see *Iridoprocne bicolor*.

Swan, Whistling, see *Olor columbianus*.

Swift, Chimney, see *Chatura pelagica*.

Syrnium nebulosum, see *Strix varia*.

Syrnium occidentale, see *Strix occidentalis*.

Syrnium varium, see *Strix varia*.

T.

Tachycineta bicolor, see *Iridoprocne bicolor*.

Tachycineta thalassina lepida—Northern violet-green swallow.

Food in California, Bul. 30, pp. 32-33
(74 stomachs).

Other notes, F. Bul. 54 (rev.), pp. 37-38.

Tanager, Scarlet, see *Piranga erythromelas*.
Summer, see *Piranga rubra*.

Tres Marias, see *Piranga bidentata flammea*.

Western, see *Piranga ludoviciana*.

Tantalus loculator, see *Myiarteria americana*.

Teal, Blue-winged, see *Querquedula discors*.

Green-winged, see *Nettion carolinense*.

Telmatodytes palustris—Long-billed marsh wren.

Food at Marshall Hall, Bul. 17, pp. 20, 33, 34, 35, 38, 40, 43, 107 (5 stomachs).

Food in California, Bul. 30, pp. 62-64
(53 stomachs).

Food of nestlings, Ybk. 1900, p. 436.

Tern, Arctic, see *Sterna paradisæa*.

Black, see *Hydrochelidon nigra surinamensis*.

Royal, see *Sterna maxima*.

Sooty, see *Sterna fuscata*.

Tetrao urogallus—Capercaillie.

Feeding on birches and conifers, F. Bul. 197, p. 15.

Thrasher, Brown, see *Toxostoma rufum*.

California, see *Toxostoma redivivum*.

Leconte's, see *Toxostoma lecontei*.

Sage, see *Oreoscoptes montanus*.

Thrush, Gray-cheeked, see *Hylocichla alba*.

Hermite, see *Hylocichla guttata*.

Thrush, Olive-backed, see *Hylocichla ustulata*.

Russet-backed, see *Hylocichla ustulata*.

Song, see *Turdus iliacus*.

Varied, see *Ixoreus naevius*.

Wood, see *Hylocichla mustelina*.

Thryomanes bewicki—Bewick's wren.

Feeding on boll weevil, Circ. 64, pp. 4, 5; scale insects, Ybk. 1906, p. 194.

Food in California, Bul. 30, pp. 57-60
(146 stomachs).

Thryothorus ludovicianus—Carolina wren.

Brief account, Bul. 38, p. 86.

Feeding on boll weevil, Bul. 22, pp. 8, 16; Bul. 25, pp. 9, 14, 21; Bul. 29,

pp. 6, 21-22, 29, 30; Bul. 38, p. 86;
Circ. 64, pp. 4, 5.

Food at Marshall Hall, Bul. 17, pp. 30, 32, 107.

Titmouse, Black-crested, see *Bæolophus atricristatus*.

Blue, see *Cyanistes caeruleus*.

Bridled, see *Bæolophus wollweberi*.

Great, see *Parus major*.

Long-tailed, see *Ægithalos caudatus*.

Marsh, see *Pœcile palustris*.

Plain, see *Bæolophus inornatus*.

Tufted, see *Bæolophus bicolor*.

Totanus flavipes—Yellowlegs.

Feeding on grasshoppers, Circ. 79, p. 4.

Towhee, see *Pipilo erythrophthalmus*.

California, see *Pipilo crissalis*.

Green-tailed, see *Oreospiza chlorura*.

Spotted, see *Pipilo maculatus subsp.*

Spurred, see *Pipilo maculatus megalonyx*.

Toxostoma lecontei—Leconte's thrasher.

Food in captivity, Fauna 7, p. 129.

Toxostoma redivivum—California thrasher.

Food in California, Bul. 30, pp. 55-56
(82 stomachs).

Toxostoma rufum—Brown thrasher.

Brief account, Bul. 38, p. 86; F. Bul. 54, pp. 34-35 (121 stomachs); F.

Bul. 54 (rev.), pp. 40-41 (121 stomachs); Ybk. 1900, p. 415.

Feeding on boll weevil, Bul. 22, pp. 11, 16; Bul. 25, pp. 9, 14, 15, 21; Bul.

29, pp. 6, 23, 30; Circ. 64, p. 5; mahaleb cherries, Bul. 32, p. 65.

Food at Marshall Hall, Bul. 17, pp. 32, 38, 56, 60, 105-106.

Food of nestlings, Ybk. 1900, p. 415.

Formal report, Ybk. 1895, pp. 405, 406, 411-415, 418 (121 stomachs).

Other notes, Bul. 30, p. 55.

Reference to studies of food habits, Ybk. 1899, p. 266.

Request for information on economic value, Ent. Circ. 20 [p. 21].

Tringa canutus—Knot.

Feeding on crayfishes, *Circ.* 79, p. 6;
Dytiscidae, *Circ.* 79, p. 8; grasshoppers, *Circ.* 79, p. 4; *Nereis*, *Circ.* 79, p. 8.

Trochilus colubris, see *Archilochus colubris*.
Troglodytes aëdon—House wren.

Beneficial, *Ybk.* 1897, p. 670.

Brief account, *F. Bul.* 54, pp. 35–36 (52 stomachs); *F. Bul.* 54 (rev.), pp. 41–42 (52 stomachs); *Ybk.* 1900, p. 413.

Food at Marshall Hall, *Bul.* 17, pp. 24, 25, 26, 30, 32, 33, 34, 35, 38, 45–46, 49, 106–107, 110 (20 stomachs).

Food in California, *Bul.* 30, pp. 60–62 (36 stomachs).

Food of nestlings, *Ybk.* 1900, pp. 413–415; *Ybk.* 1902, p. 216.

Formal report, *Ybk.* 1895, pp. 405, 406, 410–418 (52 stomachs).

Other notes, *Bul.* 1, pp. 96, 275; *Ybk.* 1904, p. 514.

Reference to studies of food habits, *Ybk.* 1899, p. 266.

Trogon ambiguus goldmani—Goldman's trogon.

Feeding on wild fig, *Fauna* 14, p. 61.

Tryngites subruficollis—Buff-breasted sandpiper.

Feeding on grasshoppers, *Circ.* 79, p. 2.

Turdus iliacus—Song thrush.

Admission denied, *Rept.* 1908, p. 581.

Admission to Western Australia prohibited, *Rept.* 1899, p. 68; *Ybk.* 1898, p. 109.

Injurious in Australasia, *Rept.* 1899, p. 68; *Ybk.* 1898, p. 109.

Turdus merula—Blackbird.

Admission to West Australia prohibited, *Rept.* 1899, p. 68; *Ybk.* 1898, p. 109.

Economic status, introduction dangerous, etc., *Ybk.* 1898, pp. 90, 106, 107, 109; *Ybk.* 1909, p. 257.

Injurious in Australasia, *Rept.* 1899, p. 68; *Ybk.* 1898, p. 109, in New Zealand, *Ybk.* 1909, p. 257.

Turdus musicus, see *Turdus iliacus*.Turkey, Merriam's, see *Meleagris gallopavo merriami*.

Wild, see *Meleagris gallopavo silvestris*.

Turnstone, see *Arenaria interpres*.*Tympanuchus americanus*—Prairie chicken.

Brief account, *Ybk.* 1900, p. 432.

Feeding on potato beetle, *Bul.* 32, p. 47; weed seeds, *Ybk.* 1898, p. 231.

Food of nestlings, *Ybk.* 1900, p. 432.

Formal report, *Bul.* 24, pp. 10–18, 23 (71 stomachs).

Tympanuchus cupido—Heath hen.

Brief account, *Bul.* 24, pp. 18–19.

Tympanuchus pallidicinctus—Lesser prairie chicken.

Brief account, *Bul.* 24, pp. 19–20.

Tyrannus tyrannus—Kingbird.

Brief account, *Bul.* 38, p. 53; *F. Bul.* 54, pp. 11–12 (281 stomachs); *F. Bul.* 54 (rev.), pp. 14–15 (420 stomachs); *Ybk.* 1900, p. 426.

Feeding on bees, *Bul.* 34, pp. 32–33; *Rept.* 1899, p. 69; boll weevil, *Bul.* 29, pp. 6, 14, 15, 24, 29, 30; *Circ.* 64, p. 5; cherries, *Rept.* 1890, p. 282; mahaleb cherries, *Bul.* 32, p. 65; mulberries, *Rept.* 1890, p. 285; robber flies, *Rept.* 1899, p. 69; rose beetles, *Bul.* 32, p. 20.

Food at Marshall Hall, *Bul.* 17, pp. 17, 22, 23, 24, 26, 30, 31–32, 33, 34, 36, 37, 38, 39, 40, 56, 59, 60, 61, 91–92 (16 stomachs).

Food of nestlings, *Ybk.* 1900, p. 426.

Formal report, *Rept.* 1893, pp. 233–234 (171 stomachs).

Other notes, *Ybk.* 1904, p. 514.

Reference to studies of food habits, *Ybk.* 1899, p. 266.

Relation to bees, *Bul.* 34, pp. 32–33; *Rept.* 1899, p. 69.

Tyrannus verticalis—Arkansas kingbird.

Brief account, *F. Bul.* 54 (rev.), pp. 15–16 (62 stomachs).

Food in California, *Bul.* 34, pp. 32–34 (78 stomachs).

Tyrannus vociferans—Cassin's kingbird.

Brief notes on food, *Bul.* 34, p. 34; *F. Bul.* 54 (rev.), p. 16.

U.

Uria lomvia arra—Pallas's murre.

Food of nestlings, *Ybk.* 1900, p. 433.

Urinator arcticus, see *Gavia arctica*.*Uroloncha aucticauda*—Japanese nun.

Admission to Hawaii denied, *Rept.* 1909, p. 542.

Urubutinga anthracina—Mexican black hawk.

Beneficial, *Circ.* 61, p. 3; *Ybk.* 1894, p. 217; *Ybk.* 1895, p. 590; *Ybk.* 1896, p. 628.

Formal report, *Bul.* 3, pp. 11, 84–85 (6 stomachs).

V.

Veery, see *Hylocichla fuscescens*.*Vermivora celata lutescens*—Lutescent warbler.

Feeding on scale insects, *Ybk.* 1906, p. 194.

Food in California, *Bul.* 30, pp. 48, 51 (65 stomachs).

Vireo belli pusillus—Least vireo.

Feeding on scale insects, *Ybk.* 1906, p. 194.

Vireo, Cassin's, see *Lanivireo solitarius cassini*.*Vireo flavifrons*, see *Lanivireo flavifrons*.*Vireo gilvus*, see *Vireosylva gilva*.

- Vireo griseus*—White-eyed vireo.
Feeding on scale insects, Ybk. 1906, p. 195.
Food at Marshall Hall, Bul. 17, pp. 20, 23, 26, 29, 34, 35, 40, 59, 60, 61, 102 (10 stomachs).
- Vireo huttoni*—Hutton's vireo.
Feeding on scale insects, Ybk. 1906, p. 194.
Food in California, Bul. 30, pp. 41-42 (54 stomachs).
- Vireo*, Hutton's, see *Vireo huttoni*.
Vireo, Least, see *Vireo belli pusillus*.
Vireo olivaceus, see *Vireosylva olivacea*.
Vireo, Red-eyed, see *Vireosylva olivacea*.
Vireo solitarius cassini, see *Lanivireo solitarius cassini*.
Vireo, Warbling, see *Vireosylva gilva*.
Vireo, White-eyed, see *Vireo griseus*.
Vireo, Yellow-throated, see *Lanivireo flavifrons*.
- Vireosylva gilva*—Warbling vireo.
Feeding on mulberries, Rept. 1890, p. 285; scale insects, Ybk. 1906, p. 194.
Food at Marshall Hall, Bul. 17, pp. 30, 35, 40, 102.
Food in California, Bul. 30, pp. 39-40 (110 stomachs).
- Vireosylva olivacea*—Red-eyed vireo.
Brief account, Bul. 38, p. 73.
Feeding on mulberries, Rept. 1890, p. 285; scale insects, Ybk. 1906, p. 195.
Food at Marshall Hall, Bul. 17, pp. 20, 23, 24, 29, 30, 34, 35, 39, 40, 43, 56, 59, 60, 61, 102 (13 stomachs).
Food of nestlings, Ybk. 1900, p. 416.
- Vulture, Black, see *Catharista urubu*.
California, see *Gymnogyps californianus*.
Turkey, see *Cathartes aura septentrionalis*.

W.

- Warbler, Audubon's, see *Dendroica auduboni*.
Bay-breasted, see *Dendroica castanea*.
Black-and-white, see *Mniotilta varia*.
Black-poll, see *Dendroica striata*.
Black-throated blue, see *Dendroica caerulescens*.
Black-throated green, see *Dendroica virens*.
Canadian, see *Wilsonia canadensis*.
Cape May, see *Dendroica tigrina*.
Lutescent, see *Vermivora celata lutescens*.
Magnolia, see *Dendroica magnolia*.
Myrtle, see *Dendroica coronata*.
Palm, see *Dendroica palmarum*.
Parula, see *Compothlypis americana*.
Pine, see *Dendroica vigosii*.

- Warbler, Prairie, see *Dendroica discolor*.
Prothonotary, see *Protonotaria citrea*.
Townsend's, see *Dendroica townsendi*.
Wilson's, see *Wilsonia pusilla*.
Worm-eating, see *Helminthos vermivorus*.
Yellow, see *Dendroica aestiva*.
- Water-thrush, see *Seiurus noveboracensis*.
Louisiana, see *Seiurus motacilla*.
- Water-turkey, see *Anhinga anhinga*.
- Waxwing, Bohemian, see *Bombocilla garrula*.
Cedar, see *Bombocilla cedrorum*.
- Weaver bird, Madagascar, see *Foudia madagascariensis*.
- Whippoorwill, see *Antrostomus vociferus*.
White-eye, South African, see *Zosterops capensis*.
- Widgeon, see *Mareca americana*.
- Wilsonia canadensis*—Canadian warbler.
Feeding on scale insects, Ybk. 1906, p. 195.
Food at Marshall Hall, Bul. 17, pp. 20, 29, 34, 39, 103-104.
- Wilsonia pusilla*—Wilson's warbler.
Feeding on scale insects, Ybk. 1906, p. 194.
Food at Marshall Hall, Bul. 17, pp. 20, 24, 103-104.
Food in California, Bul. 30, pp. 51-52 (52 stomachs).
- Woodcock, see *Philohela minor*.
- Woodpecker, Arctic three-toed, see *Picoides arcticus*.
Arizona, see *Dryobates arizonae*.
California, see *Melanerpes formicivorus bairdi*.
Downy, see *Dryobates pubescens*.
Gila, see *Centurus uropygialis*.
Golden-fronted, see *Centurus aurifrons*.
Grayson's, see *Dryobates scalaris graysoni*.
Hairy, see *Dryobates villosus*.
Ivory-billed, see *Campephilus principalis*.
Lewis's, see *Asyndesmus lewisi*.
Nuttall's, see *Dryobates nuttalli*.
Pileated, see *Phloeotomus pileatus*.
Red-bellied, see *Centurus carolinus*.
Red-cockaded, see *Dryobates borealis*.
Red-headed, see *Melanerpes erythrocephalus*.
San Lucas, see *Dryobates scalaris lucasanus*.
Texas, see *Dryobates scalaris bairdi*.

- Woodpecker, Three-toed, see *Picoides americanus*.
 White-headed, see *Xenopicus albolaryvatus*.
 Yellow-bellied, see *Sphyrapicus varius*.
 Wren, Bewick's, see *Thryomanes bewicki*.
 Cactus, see *Heleodytes brunneicapillus couesi*.
 Carolina, see *Thryothorus ludovicianus*.
 Dotted cañon, see *Catherpes mexicanus punctulatus*.
 House, see *Troglodytes aëdon*.
 Long-billed marsh, see *Telmatodytes palustris*.
 Rock, see *Salpinctes obsoletus*.
 Winter, see *Nannus hiemalis*.
 Wren tit, see *Chamaea fasciata*.

X.

- Xanthocephalus xanthocephalus*—Yellow-headed blackbird.
 Brief account, Ybk. 1897, pp. 345, 351, 353.
 Damage to corn, Ybk. 1894, p. 237; grain, Rept. 1887, pp. 428, 429, 430, 454, 455, 456; Ybk. 1897, pp. 345, 351, 353; Ybk. 1898, p. 230.
 Feeding on weed seeds, Ybk. 1898, p. 230.
 Formal report, Bul. 13, pp. 9, 11, 30-33 (138 stomachs).
 Other notes, Rept. 1887, pp. 428, 429, 430.
Xenopicus albolaryvatus — White-headed woodpecker.
 Brief account, Bul. 37, p. 63.

Y.

- Yellow-hammer [of Europe], see *Emberiza citrinella*.
 Yellowlegs, see *Totanus flavipes*.
 Yellowthroat, see *Geothlypis trichas*.

Z.

- Zamelodia ludoviciana*—Rose-breasted grosbeak.
 Beneficial, Ybk. 1897, p. 670.
 Brief account, F. Bul. 54, pp. 28-30; F. Bul. 54 (rev.), pp. 34-35; F. Bul. 456, pp. 7-9, 12, 13.
 Feeding on potato beetle, Bul. 17, p. 25; Bul. 34, p. 93; Rept. 1888, pp. 535-536; Rept. 1889, p. 369; Rept. 1905, pp. 306, 314; Rept. 1906, p. 415; Ybk. 1907, pp. 173, 175; scale insects, Ybk. 1906, pp. 192, 195; weed seeds, Ybk. 1898, p. 230.
 Food of nestlings, Ybk. 1900, p. 418.
 Formal report, Bul. 32, pp. 33-59, 71, 91 (176 stomachs),

Zamelodia ludoviciana—Continued.

- Other notes, Bul. 1, p. 323; Fauna 27, p. 449.
 Reference to studies of food habits, Ybk. 1899, p. 266.
Zamelodia melanocephala — Black-headed grosbeak.
 Brief account, F. Bul. 54 (rev.), pp. 35-36 (70 stomachs); F. Bul. 456, pp. 9-10, 12, 13.
 Feeding on black olive scale, Rept. 1905, p. 306; cherries, Bul. 34, p. 55; codling moth, Rept. 1904, p. 293; scale insects, Ybk. 1906, pp. 192, 194.
 Food in California, Bul. 34, pp. 93-96 (225 stomachs).
 Formal report, Bul. 32, pp. 60-77, 91 (226 stomachs).
 Relation to fruit in California, Bul. 30, p. 13; Ybk. 1904, pp. 246, 248, 251.
Zenaidura macroura carolinensis—Mourning dove.
 Brief account, Bul. 38, p. 36; F. Bul. 54 (rev.), pp. 6-7 (237 stomachs); Ybk. 1900, p. 431.
 Damage to grain, Ybk. 1897, p. 352; Ybk. 1898, pp. 231-232.
 Feeding on seeds of bunch grass (*Oryzopsis cuspidata*). Fauna 7, p. 32; Hungarian grass (*Setaria italica*), Rept. 1887, p. 429; weeds, Bul. 12, pp. 16-17; Bul. 12 (rev.), p. 24; Bul. 15, pp. 38-39; Ybk. 1898, pp. 222, 231-232.
 Food at Marshall Hall, Bul. 17, pp. 13, 43, 69, 70, 71, 77-78, 85, 111.
 Food of nestlings, Ybk. 1900, p. 431.
 Killed by eating poisoned grain, Bul. 23, p. 13; Circ. 76, p. 13; Ybk. 1908, p. 308.
 Other notes, Bul. 15, p. 74; Ybk. 1904, p. 514; Ybk. 1907, p. 170.
Zonotrichia albicollis—White-throated sparrow.
 Brief account, Bul. 38, p. 64.
 Feeding on boll weevil, Bul. 22, pp. 11, 16; Bul. 25, pp. 9, 12, 21; Bul. 29, pp. 6, 19-20, 30; Circ. 64, pp. 3, 5; waste oats, Fauna 33, p. 83; weed seeds, F. Bul. 54, p. 28; F. Bul. 54 (rev.), p. 32; Ybk. 1898, pp. 222, 224, 225, 226, 227.
 Food at Marshall Hall, Bul. 17, pp. 16, 22, 30, 33, 34, 35, 38, 57, 71, 73, 75, 77 (17 stomachs).
 Formal report, Bul. 15, pp. 15, 18, 26, 27, 28, 37, 39, 41, 42, 43, 45, 46, 72-75, 83, 90, (217 stomachs).
Zonotrichia coronata—Golden-crowned sparrow.
 Feeding on weed seeds, Bul. 15, p. 27; Ybk. 1898, pp. 222, 225, 226.
 Food in California, Bul. 34, pp. 78-79, 84 (184 stomachs).

Zonotrichia leucophrys — White-crowned sparrow.

Feeding on scale insects, Ybk. 1906, p. 194; weed seeds, F. Bul. 54, p. 28; F. Bul. 54 (rev.), p. 32; Ybk. 1898, pp. 222, 225, 226, 227.

Food in California, Bul. 34, pp. 75-77, 84, 85 (516 stomachs).

Formal report, Bul. 15, pp. 21, 25, 27, 28, 69-72, 74, 83, 90 (217 stomachs).

Other notes, Fauna 7, p. 89.

Zonotrichia leucophrys—Continued.

Relation to fruit in California, Ybk. 1904, p. 247.

Zonotrichia querula—Harris's sparrow.

Feeding on weed seeds, Ybk. 1898, p. 226.

Formal report, Bul. 15, pp. 27, 28, 68-69 (100 stomachs).

Zosterops capensis—South African white-eye.

Feeding on scale insects, Ybk. 1906, p. 192.

ADDITIONAL COPIES of this publication may be procured from the SUPERINTENDENT OF DOCUMENTS, Government Printing Office, Washington, D. C., at 10 cents per copy





BULLETIN OF THE U.S. DEPARTMENT OF AGRICULTURE



No. 107

Contribution from the Bureau of Biological Survey, Henry W. Henshaw, Chief.
July 27, 1914.

(PROFESSIONAL PAPER.)

-D-

BIRDS IN RELATION TO THE ALFALFA WEEVIL.

By E. R. KALMBACH, Assistant Biologist.

INTRODUCTION.

The alfalfa weevil (*Phytonomus posticus* Gyll.), a pest introduced into the United States, has for several years been doing enormous damage to alfalfa crops in Utah. On invitation of and in cooperation with the Bureau of Entomology, the Biological Survey therefore undertook to ascertain the part played by birds and mammals in checking the increase of the weevil. Accordingly the writer spent from May 8 to July 25, 1911, and from April 1 to August 15, 1912, at various points in the infested region, investigating the food habits of local birds and of a few batrachians and other vertebrates. This bulletin chiefly considers the food habits of birds, but facts concerning the economic status of other vertebrates also are included.



FIG. 1.—Known distribution of the alfalfa weevil (*Phytonomus posticus*), May 1, 1914. (Map by Bureau of Entomology.)

IMPORTATION AND SPREAD OF THE ALFALFA WEEVIL IN UTAH.

The time and method of initial introduction of the alfalfa weevil into Utah is unknown, but the first serious damage was noted in the spring of 1904, when a small infestation a few miles southeast of Salt Lake City was discovered. From this foothold the weevil spread and by September, 1911, had extended as far north as Tremonton,

NOTE.—This bulletin discusses the food habits and economic status of birds, and of the toad, frog, and a few other vertebrate enemies of the alfalfa weevil in Utah.

Utah, east to Evanston, Almy, and Lyman, Wyo., and northeast to Cokeville, Wyo., Randolph and Laketown, Utah, and Fish Haven, Idaho.¹

An insect must become fairly common before it can form an appreciable portion of the food of birds; in most of the area covered by the writer's investigations the weevil probably had not become abundant until 1907 or 1908, and doubtless had not attracted the attention of birds much before that time. Thus any preference shown by birds for this character of food was necessarily acquired in the short period of four or five years.

LIFE HISTORY OF THE WEEVIL.²

The alfalfa weevil is a small snout beetle a little less than one-fourth inch in length, and when it appears in spring its color is very dark brown or black. It passes the winter in the adult stage, protected under piles of rubbish, in vegetation along ditch banks, the base of haystacks, etc. The beetles soon become active, and on fair, warm days may be found flying, sometimes in considerable numbers, when some fall prey to the earlier arrivals among the flycatchers and swallows. At this time of year the numbers are at the lowest ebb, since comparatively few survive the rigors of winter and live to perpetuate the race.

The seasonal activities of the insect are influenced strongly by temperature. In normal years many eggs are laid by the first of April and the bulk before the middle of June, but the process may continue as late as July.

From 10 to 12 days elapse before hatching. The pale, newly hatched larvæ soon work their way to the tender leaves and growing buds at the top of stalks, where for some time they may easily escape the notice even of birds, being of such minute size and confining their early feeding to the inner folds of the leaves. At first the larvæ restrict their depredations to the more succulent portions of the foliage, but by the time they have become full sized they feed anywhere upon the plant where green leaves remain.

The larvæ become full-grown in from 20 to 60 days, and during this time they pass through three stages. When fully developed they are about one-fourth of an inch long, of a bright green color, and have a conspicuous white stripe down the back. A paler stripe on each side and the black head aid in distinguishing it from other larvæ.

¹ Webster, F. M., Bull. 112, Bu. of Entomology, U. S. Dept. of Agr., May, 1912.

² The entomological data here given are from Bull. 112 of the Bu. of Entomology, U. S. Dept. of Agr., by F. M. Webster, and Bull. 110, Utah Agr. Coll. Exp. Sta., by E. G. Titus.

In the Salt Lake Valley the bulk of the larvæ appear in May and June, but at higher altitudes somewhat later. The period of greatest abundance is at the time of the first alfalfa harvest. The insects usually make heavy inroads on the first crop and after the harvest do serious harm by retarding the growth of the second crop. All new shoots are devoured as soon as they appear, and a field frequently remains barren for three to five weeks after the first cutting.

When full-grown the larvæ cease feeding, drop to the ground, and spin rather loosely woven cocoons, which are often attached to dry vegetation at the base of the plant. The insect now passes through the pupal stage and in from one to two weeks emerges as the adult. In this stage it is covered with many fine scales or hairs which give it a light brown color. The adults begin to appear in large numbers about the first of July and may often be found clustering by hundreds upon vegetation about the borders of recently cut fields or near the bases of newly constructed haystacks. Frequently they feed upon the foliage and scar the stems of plants other than the Leguminosæ; the writer has seen healthy amaranth plants laid prostrate in a comparatively few hours.

After a short period of flight, when again some may fall prey to birds that feed on the wing, the insects seek hidden places for the winter's hibernation. Beginning soon after early August the weevils appear less in evidence.

DISTRIBUTION OF WEEVIL-EATING BIRDS IN THE TERRITORY COVERED BY FIELD WORK.

The following somewhat general synopsis of the distribution and relative abundance in Utah of native birds will give a fair idea of the species most available as aids in the fight against the alfalfa weevil. This, combined with details regarding each species, as later presented, will show which birds are doing the most good in any locality.

One of the regions most severely infested by the weevil was that immediately south and southwest of Salt Lake City, extending east and west to the edge of the irrigated land. This has an average width of 4 miles and through it flows the Jordan River. In this area the English sparrow is the most abundant bird. Next comes Brewer's blackbird and in smaller numbers are the red-winged blackbirds, which confine the bulk of their feeding to the vicinity of marshes along the river or places where lack of drainage has produced ponds. Following these are Brewer's, vesper, and lark sparrows, and meadowlarks. Robins, though very numerous in migration, are not so frequently met at a later date. The remaining common birds, named approximately in the order of their abundance,

are the rough-winged swallow, house finch, killdeer, horned lark, Arkansas kingbird, mourning dove, California quail, Bullock's oriole, black-headed grosbeak, cowbird, and yellow-headed blackbird.

A bird population differing in relative numbers from that of the region just described is found in Davis County, lying to the north of Salt Lake City and extending from the Wasatch Mountains to the Lake. As the area is narrow (at Farmington only about 4 or 5 miles wide), and is bordered on one side by the foothills and on the other by the barren flats of Great Salt Lake, a great variety of bird life may be found on a single farm. The English sparrow is not so plentiful, Brewer's blackbird being the most abundant species, but nearer the Lake the red-wings and yellow-heads vie with it for supremacy in numbers. California gulls sometimes occur in flocks of several hundred, especially where land is being cultivated. Magpies also are conspicuous and breed extensively in trees growing along creeks. The other species previously mentioned maintain about the same relative abundance, except that robins, Arkansas kingbirds, and other flycatchers are somewhat more numerous.

In the valley of the Weber the number of species is more limited, but there is no dearth of individuals. Here, as well as along Chalk Creek, which flows into the Weber, irrigated fields border the river in a long narrow strip, 1 to 2 miles wide. Bird life has segregated itself in these fields, while large numbers of birds which build in the sagebrush of the surrounding hills secure the bulk of food for themselves and their young in the lower, more fertile, tracts.

A "bench" lying to the east of this section and at some distance from the river afforded similar conditions and proved a most excellent feeding area for a number of more or less desert species dwelling on the sides of adjacent hills. Brewer's blackbirds were the most abundant, while along the upper borders of these fields and on the "bench" Brewer's, vesper, chipping, lark, and savannah sparrows appeared in great numbers. The green-tailed towhee, sage thrasher, and mountain bluebird also were present. On the lower fields robins were very numerous and bobolinks not uncommon, but no English sparrows were found.

The section about Alpine and American Fork, in Utah County, presented an avifauna very similar to that immediately south of Salt Lake City.

BIRDS FEEDING ON THE WEEVIL.

The following list includes all of the important bird enemies of the alfalfa weevil. Probably some spring migrants pick up a few while passing and some resident species, whose ordinary habits and food preferences would seem to preclude them from being enemies of the weevil, may occasionally feed on them. In the two

seasons' work 45 species of birds were found to have eaten the insect, as follows:

California gull (*Larus californicus*).
 Wilson's phalarope (*Steganopus tricolor*).
 Killdeer (*Oxyechus vociferus*).
 Valley quail (*Lophortyx californica vallicola*).
 Western mourning dove (*Zenaidura macroura marginella*).
 Red-shafted flicker (*Colaptes cafer collari*).
 Arkansas kingbird (*Tyrannus verticalis*).
 Say's phoebe (*Sayornis sayus*).
 Traill's flycatcher (*Empidonax trailli trailli*).
 Desert horned lark (*Otocoris alpestris leucolæma*).
 Magpie (*Pica pica hudsonia*).
 Long-crested jay (*Cyanocitta stelleri diademata*).
 Woodhouse's jay (*Aphelocoma woodhousei*).
 Bobolink (*Dolichonyx oryzivorus*).
 Cowbird (*Molothrus ater ater*).
 Yellow-headed blackbird (*Xanthocephalus xanthocephalus*).
 Thick-billed redwing (*Agelaius phæniceus fortis*).
 Western meadowlark (*Sturnella neglecta*).
 Bullock's oriole (*Icterus bullocki*).
 Brewer's blackbird (*Euphagus cyanocephalus*).
 House finch (*Carpodacus mexicanus frontalis*).
 Pine siskin (*Spinus pinus*).
 Western vesper sparrow (*Poæcetes gramineus confinis*).
 Western savannah sparrow (*Passerculus sandwichensis alaudinus*).
 Western lark sparrow (*Chondestes grammacus strigatus*).
 White-crowned sparrow (*Zonotrichia leucophrys leucophrys*).
 Western chipping sparrow (*Spizella passerina arizonæ*).
 Brewer's sparrow (*Spizella breweri*).
 Desert song sparrow (*Melospiza melodia fallax*).
 Lincoln's sparrow (*Melospiza lincolni lincolni*).
 Spurred towhee (*Pipilo maculatus montanus*).
 Green-tailed towhee (*Oreospiza chlorura*).
 Black-headed grosbeak (*Zamelodia melanocephala*).
 Lazuli bunting (*Passerina amæna*).
 Cliff swallow (*Petrochelidon lunifrons lunifrons*).
 Bank swallow (*Riparia riparia*).
 Rough-winged swallow (*Stelgidopteryx serripennis*).
 Yellow warbler (*Dendroica æstiva æstiva*).
 Macgillivray's warbler (*Oporornis tolmiei*).
 Long-tailed chat (*Icteria virens longicauda*).
 Sage thrasher (*Oreoscoptes montanus*).
 Long-tailed chickadee (*Penthestes atricapillus septentrionalis*).
 Western robin (*Planesticus migratorius propinquus*).
 Mountain bluebird (*Sialia currucoides*).
 English sparrow (*Passer domesticus*).

CALIFORNIA GULL.

(*Larus californicus*.)

No bird in the Salt Lake Valley is held in so great esteem by the people of Utah as the California gull. On numerous occasions in

spring the writer witnessed the work of this bird on alfalfa fields, where it was common to see 200 to 300 following a harrow or plow in search of grubs, cutworms, and other insects turned up. Only five gulls were examined, and all but one were from badly infested alfalfa fields. In the stomach of only one was the weevil found.

Other prey, such as earthworms, ground beetles, and fly larvæ, seemed more attractive than the weevil to these birds. Apparently some had recently been feeding on the barren alkali flats surrounding Great Salt Lake. In one stomach were about 450 of the small carabid beetle (*Pogonus planatus*), so common about the decayed bodies of waterfowl which have died of disease in the vicinity of the Jordan River marsh, and in another were large numbers of pupæ of the alkali fly (*Ephydra gracilis*).

Though the California gull is one of the most valuable of Utah birds, as a weevil destroyer it is unimportant. However, so important are its services in other directions that it deserves the careful protection it receives.

WILSON'S PHALAROPE.

(*Steganopus tricolor*.)

A single stomach of Wilson's phalarope was examined, and the remains of one adult weevil were detected. Wilson's phalarope, however, can not be expected to render much service as a weevil destroyer, as its feeding habits restrict it largely to the immediate vicinity of lake shores and river banks.

KILLDEER.

(*Oxyechus vociferus*.)

The killdeer is found everywhere in the Salt Lake Valley, even to the upper edges of watered lands, where the highest irrigating ditches supply it with all the aquatic environment it needs. However, it appears to be more widely scattered in the spring than later in the season, when more are found about Great Salt Lake and along the Jordan River. Irrigation on an alfalfa field is always a great attraction, and in such situations as many as six or eight of these birds may be found in a field of three to four acres. Cutworms here fall easy prey.

Nineteen killdeers were examined, six of which were obtained in April. The weevil, aggregating 3.5 per cent of the food, was found in five of the six taken in that month. In each case the adult form was eaten and was found on an average of $4\frac{2}{3}$ per stomach.

Caterpillars (cutworms in some cases) constituted nearly 37 per cent of the food, and ground beetles came next with a percentage of 19.3. A large quantity of aquatic beetles in one stomach brought the monthly average of this food up to nearly 9 per cent, while

carriion beetles (*Silphidæ* and *Staphylinidæ*), click beetles, dung beetles (*Aphodius*), and weevils other than *Phytonomus* were frequent constituents of the remaining animal food. The vegetable portion was either weed seeds or rubbish.

Three of five killdeer obtained in May had fed on the weevil to the extent of over 36 per cent of the food. In one, these insects composed the entire contents, save a trace of darkling and ground beetles. It required no less than 40 adults and 1 larva of the weevil to satisfy this bird's appetite. Another had eaten 18 adults.

Of the other food taken during May, spiders, ground beetles, aquatic beetles, flies, bees, and wasps occurred in quantities decreasing in the order named. The high proportion of spiders recorded was the result of one of the birds having fed on them almost exclusively. A few grain hulls in one stomach probably came from waste material.

The food for June, as learned from examination of eight stomachs, gives a good idea of what may be expected of the killdeer under favorable conditions. The weevil formed nearly a third of the monthly food, and was present in all of the stomachs but one. Of two birds which had destroyed surprisingly large numbers of the insect, one, from a newly cut field, had eaten 9 adults and 307 larvæ, and the other, feeding under similar conditions, had made away with 7 adults and 376 larvæ. A third had taken 42 larvæ and 1 adult.

Of other animal food items for this month ground beetles occurred in the greatest quantity. They were present in 6 of the 8 stomachs and comprised over 15 per cent of the monthly food. Snails were eaten extensively by two of the birds. Darkling beetles of the genus *Blapstinus* were frequently taken and formed nearly 11 per cent of the stomach contents. Dung beetles (*Aphodius*), bill bugs (*Sphenophorus* sp.), caterpillars, and wasps were other common ingredients. The vegetable portion was again unimportant, consisting entirely of weed seeds and rubbish.

The killdeer in no part of its extensive range is known to injure farm produce. The worst that can be said of it is that in its indiscriminate destruction of insects it may pick up a few that are beneficial. These, however, form an extremely small proportion of the bird's fare, while serious pests, as mosquitoes, craneflies, grasshoppers, and weevils of various kinds, are frequent components of its food. In addition to this already exceptional record, the killdeer must be considered as one of the most effective destroyers of alfalfa weevils. In early spring the birds are frequent visitors of infested fields, where many breeding weevils fall victims to the birds' voracity. The killdeer has been rightly removed from the class of game birds, where formerly it could be shot throughout much of its range. It may now continue its good work unmolested.

VALLEY QUAIL.

(Lophortyx californica vallicola.)

The valley quail, common in the irrigated portion of Salt Lake Valley, is frequently seen about alfalfa fields. Though a little shy in such environment, it appears to be perfectly at home and succeeds in raising broods wherever it finds sufficient cover. An open season is maintained for taking this bird during the month of October in the counties of San Pete, Uinta, Salt Lake, Davis, Weber, Utah, Sevier, and Carbon, while in some of the less densely populated sections a longer season is provided.

The valley quail has a good record as a weevil destroyer, based on a limited amount of material, but examination of it gives a fair idea of what can be expected of this bird. One was obtained in May and four in June. In the stomach of each the weevil was present in very large numbers, and in only one did the insects number less than 100 individuals in various stages of development. The five birds had eaten, respectively, 165 larvæ and 7 adults, 126 larvæ and 1 adult, 317 larvæ and 2 adults, 128 larvæ and 1 adult, and 75 larvæ and 2 adults, a total of 811 larvæ and 13 adults. In bulk this averaged 32.4 per cent of the stomach contents and at the same time formed 95.3 per cent of the animal portion of the bird's diet. In three cases the contents of the crop, which was full, were also included. Other animal food taken was divided in small lots under several heads.

The vegetable element, which formed 66 per cent of the stomach contents, was composed largely of weed seeds. Among these were found filaree (*Erodium cicutarium*), smartweed (*Polygonum* sp.), shepherd's purse (*Capsella bursa-pastoris*), Russian thistle (*Salsola tragus*), a vetch (*Astragalus* sp.), and dandelion (*Taxaracum taxaracum*). One bird had picked up about 400 seeds of alfalfa and another a quantity of wheat, estimated to be 55 per cent of the food.

Thus the valley quail may become troublesome by feeding on grain or seeds of other cultivated crops. At present, however, it is not sufficiently abundant in Utah to be a source of anxiety, and the short open season now allowed is more than ample to keep it in check. This bird is one of the most valuable about the farm, and in Utah it appears to eat even more than its customary amount of animal food. Any change in legislation, therefore, should be in the direction of increased protection.

WESTERN MOURNING DOVE.

(Zenaidura macroura marginella.)

The reason for including the western mourning dove, an almost exclusively granivorous bird, among the weevil's enemies is based on the fragments of adults found in two stomachs. While this mourn-

ing dove can not be considered an effective enemy of the weevil, it renders service to man in the consumption of weed seeds, and as long as it does not become unduly abundant in grain fields its presence is desirable.

The vegetable food of the birds examined was largely weed seeds. Among these were those of amaranth (*Amaranthus blitoides*, *A. retroflexus* and *A. albus*), filaree (*Erodium cicutarium*), cockle (*Vaccaria vaccaria*), pigweed (*Chenopodium* sp.), ragweed (*Ambrosia artemisiifolia*), thistle (*Carduus* sp.), smartweed (*Polygonum* sp.), and sunflower (*Helianthus* sp.).

RED-SHAFTED FLICKER.

(*Colaptes cafer collaris*.)

The red-shafted flicker is sparingly distributed through the Salt Lake Valley, though the constantly increasing supply of suitable nesting sites caused by the growth of trees in the irrigated portion bids fair to increase its abundance.

Of the three birds examined, two had fed on the alfalfa weevil, a trace of an adult being present in each case. Ants, its favorite food, composed practically the entire contents of each of the stomachs. In one were no less than 390 adults and 190 pupæ of the small dark brown ant, *Myrmica scabrinodis*.

Although the flicker is the most terrestrial of woodpeckers it does little toward the reduction of the weevil, as it lives chiefly on ants. In this it doubtless is working for the best interests of man, as many large harvest ants of the West (*Pogonomyrmex*) do considerable damage to grain and forage, not only by cutting down the crop for a space of several feet about their domicile, but by building nests which menace the operation of the mower or reaper.

ARKANSAS KINGBIRD.

(*Tyrannus verticalis*.)

The Arkansas kingbird probably is the most abundant and evenly distributed flycatcher in the Salt Lake Valley. Though it is more at home in arid districts, the writer met it in great abundance about ponds where flying insects furnished ample food.

Of ten birds secured four had eaten weevils, but not more than three were found in any one stomach. The small number is probably due to the fact that flycatchers are necessarily limited in this work to the short period when the weevil is on the wing, as also are swallows. The small cicada (*Platypedia putnami*) was a favorite food of these birds.

SAY'S PHŒBE.

(Sayornis sayus.)

Only three stomachs of Say's phœbe were available for examination. In one a single adult weevil was found, a dark-colored and much-worn specimen which had hibernated. The remainder of the stomach contents consisted of a varied assortment of flying insects, among which were tabanid flies, a cricket, carrion beetles (*Silpha*), a blister beetle (*Cantharis*), and several Hymenoptera.

TRAILL'S FLYCATCHER.

(Empidonax trailli trailli.)

Traill's flycatcher is found in considerable numbers in willow thickets along streams and ditches in the Salt Lake Valley. Seven birds were obtained when conditions were most favorable for feeding on the weevil, but only two had fed on the insect, a single adult being eaten in each case. The aerial feeding habits of flycatchers as a family naturally limit their consumption of the weevil to the warmest of spring days or to the later season when the brood of the year takes wing.

The food taken most frequently was Hymenoptera, ants, wild bees, and a few parasitic forms. These were found in each stomach and comprised about 43 per cent of the contents. Flies of various kinds (17.5 per cent) formed the next most important item, and beetles, bugs, and Lepidoptera were eaten in lesser quantities.

DESERT HORNED LARK.

(Otocoris alpestris leucolæma.)

The desert horned lark, a hardy little bird of the open country, is an abundant resident throughout the Salt Lake Valley, especially in winter, when it is familiarly known by the name of snowbird. It is one of the earliest species to breed and frequently its eggs may be found when the ground is still white. In early spring horned larks often feed in the wind-swept stubble of alfalfa fields, when they come in contact with hibernating weevils. Though essentially a seed-eating bird, from May to July a considerable proportion of animal food, including the larvæ of the weevil, is taken.

Three of the four birds collected in April had fed on the insect, the adult form in each case, and it formed about 3½ per cent of their food, but only one stomach contained more than one individual. The remaining animal food was characterized by a large proportion of lepidopterous remains, most of which, however, was in a single stomach. The vegetable portion, forming over half of the food, was composed almost entirely of weed seeds.

Six birds taken in May had fed on the weevil, but the number of insects eaten could not be accurately determined, as much of the food was in an advanced stage of digestion. The adults and larvæ occurred in about equal proportions. One bird had fed upon this insect to the extent of 80 per cent of its food, another 70, and a third, which had devoured 13 adults, 48 per cent. An average of over 41 per cent of the food of the six birds consisted of alfalfa weevils.

Another noteworthy animal food was a considerable quantity of caterpillars, forming over 17 per cent of the whole. Ground beetles amounted to over 6 per cent, and grasshoppers 5 per cent. The animal portion of the horned larks' food for May was nearly three-fourths of the stomach contents. The vegetable part (26.5 per cent) was divided between weed seeds and wheat. This latter element formed about two-thirds of the vegetable portion and may have been secured from recently sown fields.

Each of five larks collected in June also had fed on the weevil, which formed 29 per cent of the food. One had taken 16 adults and 1 larva, and another 10 adults and 25 larvæ. In no case did the weevil form less than 10 per cent of the stomach contents, and in one it went as high as 60 per cent.

Hemiptera, Lepidoptera (caterpillars), and spiders figured prominently in the other animal food. Of the vegetable portion, weed seeds composed the bulk.

More extensive investigations have shown that with the exceptional cases where injury is done to newly-sown grain the farmer has little to fear from this bird. Its best service is in the reduction of the annual crop of weed seeds. The lark also consumes much insect food during summer months, and in Utah the alfalfa weevil has quite naturally entered into its diet. On fair days in early spring these insects are abundant in the stubble of alfalfa fields where horned larks are common, and the destruction of the weevil at this time is a very important factor in the reduction of the numbers of the annual brood. While the consumption of adults ($3\frac{1}{2}$ per cent in April) is rather low, it is believed that at this time of year the horned larks do the most good in their fight upon the weevil.

MAGPIE.

(*Pica pica hudsonia*.)

Though only locally abundant in the Salt Lake Valley, the magpie is one of the best known of the birds of Utah. As it is somewhat gregarious in habit, from 15 to 20 nests may be found comparatively close together. Upward of 40 nests were found in one stretch extending half a mile along a creek near Kaysville. As alfalfa fields

flanked both sides of the stream, whatever was learned here concerning the magpie as a weevil enemy must be regarded as having been obtained under most favorable conditions.

Nestlings.—A series of 134 stomachs of nestlings was secured in May, and in 79 the weevil was found. It usually occurred in small numbers, the average for the lot being 4.8 weevils per bird, which amounted to 2.42 per cent of the food. Some, however, had eaten considerable numbers of the breeding adults. A half-fledged young had been fed 74 of the insects, and 5 others had eaten, respectively, 62, 55, 33, 26, and 24.

Examination of these stomachs shows how omnivorous are these birds, no less than 85 different items being recognized, besides large quantities of carrion and rubbish. In the material identified were six orders of insects, spiders, a shrimp, mollusks, a reptile, batrachians, earthworms, three species of birds, four of mammals, and seeds of eight species of plants. As each of these items has a different economic significance, the problem of the value of the magpie is complicated.

The largest animal food item was caterpillars (22.1 per cent), which occurred in 104 stomachs. Many of these were cutworms, gleaned from alfalfa fields along with the weevil. The remains of small mammals and carrion of many forms amounted to 14.75 and 11.86 per cent, respectively. Among the mammal remains were recognized meadow mice (*Microtus*), ground squirrels (*Citellus mollis*), a gopher (*Thomomys*), and a shrew (*Sorex leucogenys*). Associated with the carrion were large numbers of muscid pupæ and larvæ, which comprised 16.34 per cent of the stomach contents. It appeared from some of the material that parent birds visited a carcass of a beef or horse and removed only dipterous larvæ and pupæ, leaving the putrid animal matter as a breeding ground for more of the same. The stomachs of many young birds were nearly filled with the dipterous remains, only a few black or brown hairs indicating the source of the food. Ground beetles formed 5.15 per cent of the food, and miscellaneous Coleoptera, members of the genera *Necrophorus* and *Silpha* predominating, 4.05 per cent. Other insect food was divided in small quantities under several heads.

Other components of the animal food economically highly important were the remains of chickens and wild birds and their eggs. The feathers of what appeared to be a young chicken were found in the stomachs of two young birds of the same brood while fragments of eggshell occurred in 22 of the 134 collected. The entire stomach contents of one young magpie consisted of eggshell and what appeared to be its partially incubated contents. Another stomach was about four-fifths full of similar material.



FIG. 1.—YOUNG MAGPIES.

[Late broods of these birds were fed on alfalfa weevil larvæ.]



FIG. 2.—STRAW-THATCHED CATTLE SHED, A FAVORITE NESTING SITE FOR LARGE NUMBERS OF ENGLISH SPARROWS.

[These sheds were doubtless an important factor in maintaining the abundance of these birds in rural sections of Utah. See p. 46.]

Three of a brood of five fully fledged young had divided the remains of a small passerine bird. Another had been fed on what appeared to be the remains of a young robin, while a third had eaten eggs of the same species. The vegetable food was mainly rubbish.

In June late broods of magpies (see Pl. I, fig. 1) were frequently fed on the larvæ of the weevil. Eighteen of twenty-five birds examined had eaten the insect at an average of 5.6 adults, 0.08 pupa, and 29.24 larvæ per bird, amounting to 6.6 per cent of the stomach contents. The largest quantities of these insects occurred in this series of stomachs. A brood of six nestlings, about four to five days old, was observed in a cottonwood near the border of an alfalfa field. This field had been cut one morning, and during the afternoon the parent magpies were noticed making numerous visits, and judging from the well-filled stomachs of the young birds, the old birds had made good use of their time. This brood had consumed 36 adults, 2 pupæ, and 677 larvæ, an average of over 102 individuals per bird. As the young had also eaten a varied assortment of other food, comprising at least 25 different items, the weevil formed only 18.7 per cent of the contents.

The remaining animal food for June was essentially the same as for May, save that grasshoppers, taken in considerable numbers, amounted to over 13 per cent. Three of a brood of five had divided the remains of a sparrow, while one of another hatch had eaten the eggs of a robin.

Adults.—Being a resident the year round, the magpie was frequently seen on cold, windy April days visiting alfalfa fields. It was at first thought that bits of carrion or field mice might be the attraction, but analysis of stomachs showed that the birds were making diligent search in the stubble and under clods of earth for the adult weevils. Each of five birds examined had eaten weevils. One had taken no less than 160 adults, while others had eaten 60, 55, 45, and 19 adults, respectively. These composed 26.2 per cent of the magpie's food.

The omnivorous nature of these birds is not revealed this early, when comparatively few articles of food are available. Carrion occurred in four stomachs, amounting to over 40 per cent. Bones of a batrachian were found in another. Of the vegetable food, the larger part (19 per cent) was waste grain.

Eight magpies were collected in May, but the stomachs of three were too nearly empty to be of use. However, two of these revealed traces of adult weevils. Each of the other five had eaten this insect in quantities varying from 2 to 50 per cent of the stomach contents, while one especially remarkable stomach contained 181 adult weevils. No grain had been eaten by these birds, but there was an increased

percentage of various insect items. Numerous pupæ of a muscid fly, as well as carrion beetles (*Silpha ramosa*), were found. Carrion occurred in four of the five stomachs and amounted to over a third of the food, while the remains of a freshly killed small rodent were found in the other. The stomachs of two birds contained fragments of hen's egg.

Each of the six adult birds collected in June had fed on the weevil to the extent of 9.67 per cent of their food. One had eaten 24 adults and 180 larvæ. In one stomach were feathers of a small bird. Ground beetles, caterpillars, grasshoppers, carrion, and a small rodent composed the bulk of the remaining animal food. The vegetable element (20.5 per cent) was divided about equally between wild fruit and rubbish.

Summary.—During early spring the adult magpie is valuable as a destroyer of weevils as they come out of hibernation. Complaints that it steals hen's eggs may be practically eliminated by the proper housing and screening of nesting fowls, but as long as hens are allowed to lay eggs promiscuously about the farm magpies will continue to reap their toll. The destruction of wild birds and their eggs is doubtless the strongest argument against the species. In view of its obnoxious traits, legal protection for the bird is not recommended.

LONG-CRESTED JAY.

(*Cyanocitta stelleri diademata*.)

Deductions as to the relation of the long-crested jay to the weevil were based on the examination of a single stomach. This bird was from a densely wooded creek bottom which afforded direct egress from the shrubby vegetation of its favorite habitat to the midst of an agricultural community.

Among the stomach contents were a single adult weevil, a dung beetle (*Aphodius*), a bee, a caterpillar, carrion, grain hulls, and a mass of dandelion seeds.

The favorite habitat of wooded hillsides and canyon slopes and the natural food preferences of the long-crested jay apparently preclude it from becoming very destructive to the alfalfa weevil.

WOODHOUSE'S JAY.

(*Aphelocoma woodhousei*.)

Woodhouse's jay is fairly common wherever dense scrubby vegetation along a stream provides its favorite environment. Three stomachs were examined and adult weevils were found in each, averaging 1 per cent of the food. Ground beetles, mast, and wheat were

other important components of the food, and in the stomach of one bird were fragments of eggshell.

In view of the numerous objectionable habits of the closely related California jay it does not appear wise to recommend protection for this bird as a weevil destroyer. At the same time it is not numerous enough in agricultural districts of Utah to make any injurious habits which it may possess noticeable.

BOBOLINK.

(*Dolichonyx oryzivorus*.)

The bobolink, songster of hayfields and low meadows, is fairly common in Utah. It was found in moderate abundance in the vicinity of West and South Jordan, and Farmington, and along the Weber River and Chalk Creek in Summit County.

As a destroyer of the weevil it has an interesting record. In the stomach of each of the nine birds examined the insect was present in considerable numbers. A single bird collected in May had fed on 10 adult weevils, which formed 14 per cent of the food.

Seven bobolinks collected in June had taken the weevil at an average of about 8 adults and 42 larvæ per bird, to the extent of 68 per cent of the stomach contents. In the stomach of one, 6 adults and 90 larvæ formed the entire food. Another had eaten no less than 28 adults and 77 larvæ, amounting to 86 per cent of the stomach contents, while a third had eaten 3 adults and 61 larvæ. The only other food items in the last stomach were small fragments of a bug and a click beetle, estimated at 1 per cent. These birds also had fed to the extent of over 16 per cent of their food on caterpillars, which occurred in all but one of the stomachs. Bugs (Hemiptera) formed about half that amount.

A single bobolink collected in August had eaten 7 adults, which totaled 15 per cent of its food, while several caterpillars and lepidopterous pupæ formed an additional 71 per cent.

The bobolink does exceptionally good work as a weevil destroyer, for whenever it lives near infested alfalfa fields the insect forms its most important animal food. There appears to be no reason why it should not be fully protected. Its status in Utah is essentially the same as in the New England and other Northern States, where its economic merits have never been questioned.

COWBIRD.

(*Molothrus ater ater*.)

Previous investigations¹ of the economic status of the cowbird have shown that, judged from its food habits alone, the farmer has

¹ Beal, F. E. L., Food of the Bobolink, Blackbirds, and Grackles. Bull. 13, Biol. Survey, U. S. Dept. of Agr., 1900.

little to fear from this bird, but the fact that in its egg-laying habits it is parasitic, and frequently so on highly valuable species, has so complicated matters that its exact relation to agriculture is not yet thoroughly understood. In spring and summer the cowbird may be found usually in numbers of from two to six associated with one or more of its relatives in the vicinity of pastures or alfalfa fields. The cowbird's exceptional record as a weevil destroyer does much toward redeeming it for misdemeanors arising from its parasitism. Of the 15 birds collected only 1 had failed to feed on the insect.

Three cowbirds taken in May had eaten the weevil to the extent of over 60 per cent of their food. In one case it amounted to 95 per cent and was present at an average of about 7 adults and 30 larvæ per bird. Dung beetles (*Aphodius*) formed the bulk of the remaining animal food. Wheat, which was present in two stomachs, was estimated to be a fourth of the monthly sustenance.

Ten birds collected in June showed a continuation of the good work started in the preceding month. The only bird failing to eat the weevil was one which had taken three or four nymphs and one adult of the small cicada (*Platypedia putnami*), which formed nearly the entire stomach contents. The weevil, constituting 42.3 per cent of the food, was taken at an average of 6 adults, 1.4 pupæ, and 30.3 larvæ per bird. The largest number recorded for the species was 80 larvæ, 3 pupæ, and 3 adults, forming 80 per cent of the food. Of the remaining animal food Hemiptera was the most prominent item (18.7 per cent), and was composed of about equal parts of cicadas (*Platypedia*) and tree hoppers (Membracidæ). The vegetable food (27 per cent) was composed largely (18.3 per cent) of the seeds of weeds, among which were filaree, wild mustard, brome grass, and barnyard grass.

Two cowbirds taken in July had fed on the weevil, adults of the same year's brood in each case, to the amount of nearly 30 per cent of the stomach contents. The remains of a much-digested lepidopteran comprised about half of the food of one, and a mass of seeds of filaree, amaranth, smartweed, and sunflower formed about 80 per cent of the contents of the other stomach.

Summary.—The food habits of the cowbird in Utah during spring and summer appear to be above reproach. Grain forms but a small portion of its diet, while the alfalfa weevil is by far the largest ingredient of the animal portion. From the first of May to the middle of July the weevil forms over half the animal food, and much of the vegetable portion is composed of weed seeds. In recognition of the cowbird's work as a weevil enemy, it would appear that when every suppressive agency must be carefully conserved, the bird should be allowed to continue its good work unmolested by sportsman or small boy.

YELLOW-HEADED BLACKBIRD.

(Xanthocephalus xanthocephalus.)

The yellow-headed blackbird, or soldier bird, as he is more frequently called in the West, is the last of the three blackbirds to arrive in large numbers, although a few individuals are said to remain throughout the winter in favorable localities.

Nestling and juvenile birds.—As weevil enemies young yellow-heads do not rank as high as the nestlings of the other blackbirds. The insect amounted to 4.27 per cent of the stomach contents and occurred in 40 of 68 birds collected in June. Larvæ were preferred to adults, being taken on an average of 4.13 per bird, as compared with 0.74 for the latter. One nestling 4 or 5 days old had destroyed 48 larvæ, and a brood of three had eaten, respectively, 42, 25, and 40.

The work of a colony of about 15 or 20 yellow-heads upon an alfalfa field of three or four acres came under the writer's observation. The breeding marsh was fully half a mile from the source of food supply, and the flight of the parent birds to and from their nests was observed for about a half hour, during which the adults made visits to the fields at the rate of about one every minute.

Other animal food of the young, strongly indicative of the aquatic environment in which the bird lives, was dragonflies and their nymphs, which formed 43.86 per cent of the stomach contents, and occurred in all but 10 of the 68 stomachs. Some stomachs contained fragments of adult Odonata, which testifies to the ability of these birds to capture insects generally supposed to be effectively protected by their powers of flight. Caterpillars formed about a fourth (24.08 per cent) of the food. Ground beetles (5.7 per cent), spiders (5.54), grasshoppers (4.09), snails (3.76), and Hymenoptera (2.1) were the principal other ingredients of the animal food. The vegetable portion (2.13) was mainly rubbish.

Two juvenile birds collected in July had eaten the weevil, one of which had taken 2 adults and 30 larvæ.

Adults.—During April and May only two adult yellow-heads were collected each month, a too limited number to allow definite conclusions, but it shows that the birds were already preying upon the insect. One collected on the 23d of April had eaten a single adult, while the bulk of the stomach contents consisted of caterpillars. This latter element also composed 97 per cent of the food of the other April bird. The two birds taken in May had fed upon the insect, having eaten three and seven adults, respectively, which averaged 10 per cent of their food.

Of 21 stomachs collected in June only 4 failed to contain the weevil. The insect formed 43.48 per cent of the yellow-head's food and was taken at an average of more than 6 adults and 47 larvæ per

bird. The largest number taken by any of this species was 190 larvæ and 2 adults. Another record was 160 larvæ and 2 adults. Three adults and 117 larvæ were eaten by one bird, while five others had taken more than 170 individuals apiece.

Of the other animal food Lepidoptera, in the form of caterpillars, is most important, amounting to nearly 31 per cent. These insects occurred in 15 of the 21 stomachs and in one constituted the entire food. Ground beetles (8.56 per cent), Hemiptera (4.95), weevils other than *Phytonomus* (4.24), and dragonflies (2.48) made up the bulk of the remainder. The vegetable food (1.2 per cent) was of no economic importance.

Seven birds collected in July show a decrease in the amount of weevils eaten and a corresponding increase in other food items, as grasshoppers, flies, and grain. Only two had eaten the insect, one having taken but a single adult, while the other had made away with 48. Grain amounted to nearly half (44.57 per cent) of the food, verifying the complaint against these birds at this time of the year.

Summary.—With the exception of the work of adult birds during the month of June, the yellow-headed blackbird can not be considered as among the more effective bird enemies of the weevil, but its uniformly good work on caterpillars during the entire season argues in its favor. Its strong liking for dragonflies is against it, and also there is little doubt that it lays heavy toll on ripening and shocked grain.

THICK-BILLED REDWING.

(*Agelaius phœniceus fortis*.)

The thick-billed redwing is a common breeder throughout the Salt Lake Valley wherever is found a clump of cat-tails, a favorite nesting site. As small marshes flank the Jordan River and the shores of Salt Lake, and are about other places where imperfect drainage has left a pool, the bird is fairly well scattered throughout the valley, and of the blackbirds ranks next in abundance to Brewer's.

Those birds which do not winter in the Salt Lake Valley arrive early enough to render valuable service in the destruction of weevils emerging from hibernation. In the spring of 1912 the writer found them fairly common, and the examination of one stomach secured on the 1st of April indicated that they were already at work on the insects.

Nestlings.—Thirty of fifty young redwings examined for June had eaten the insect, which amounted to 10.64 per cent of their food, and was taken on an average of 0.3 adult and 12.58 larvæ per bird. In several instances, where nesting marshes were situated near infested fields, large numbers of larvæ were eaten. A brood of three

had consumed 60 larvæ, 84 larvæ and 1 adult, and 100 larvæ and 1 adult, respectively. Another hatch of three had averaged $32\frac{1}{3}$ larvæ apiece. Several other food items characteristic of these birds appeared with such regularity that the actual bulk of weevils in no case amounted to over 50 per cent.

Caterpillars formed the next most important item, totaling 27.38 per cent. Dragon flies (Odonata) and their nymphs, and snails, forming 9.84 and 6.46 per cent, respectively, were secured from the immediate vicinity of the nests. Spiders composed over 15 per cent, and ground beetles, with the genus *Amara* predominating, a little less than a tenth of the food. The major portion of the remaining animal food was divided about equally between aquatic beetles, bugs, flies, and grasshoppers. The vegetable food (6.84 per cent) was unimportant, as over half was rubbish taken accidentally with the food.

An observation for a period of an hour was made of a female redwing feeding a brood of four nestlings about three days old. The nest was situated in a clump of cat-tails with alfalfa fields not far distant. The parent bird divided her time between visits to the adjacent marsh and the near-by alfalfa, and made trips to the nest on an average of one every $3\frac{3}{4}$ minutes. Though the alfalfa was visited oftener than the marsh, the food of the nestlings was gleaned largely from the latter place, as over one-quarter of it was dragon flies and over half spiders, while the weevil amounted to but 7.25 per cent. The parent bird, however, had made good use of her time in the field, as her stomach contained 3 adults and 56 larvæ, comprising 45 per cent of the contents.

Adults.—The early warfare on the weevils by adult redwings is verified by examination of stomach contents, and although the insect formed but a small proportion of the bulk (4.94 per cent), it was present in 27 of the 36 birds used in this computation. Five of seven other stomachs, which were too nearly empty to be of use, also contained the insect. Weevils taken in April were breeding adults, and were eaten on an average of $2\frac{1}{3}$ per bird. The highest number eaten by any was 13.

Of other animal food, caterpillars and fly larvæ, mostly aquatic, composed slightly more than 13 per cent each. Aquatic beetles formed nearly 3 per cent and ground beetles nearly 2, while several other items occurred in small quantities, none over 1 per cent. Vegetable matter formed 57.08 per cent of the food, over half of which was grain, while the rest was divided between weed seeds (18.78) and a little rubbish.

During the month of May adult redwings increased their work on the alfalfa weevil until it comprised about one-sixth of their food, occurring in 23 of the 32 stomachs examined and averaging 4.84

adults and 2.41 larvæ per bird. The largest number of weevils in any one stomach was 12 adults and 75 larvæ. Of the remaining animal food caterpillars formed the most important element (16.63 per cent), while aquatic fly larvæ, some of which were Tipulidæ, amounted to about a tenth of the food. Ground beetles (4.44 per cent) and weevils other than *Phytonomus* (2.25 per cent) were the only other items worthy of mention. Among the latter the clover-root curculio (*Sitones*) and several species of *Sphenophorus*, living on sedges, occurred repeatedly. The vegetable element amounted to 44.9 per cent, about two-thirds of which was grain. The rest consisted of weed seeds and rubbish.

In June, the period of greatest abundance of nestlings, these birds eat the largest proportion of weevils. While parent birds are obtaining food for their young, they are inclined to partake of much the same varieties. Of 42 birds examined only 2 had failed to eat at least a trace of the weevil, and it was taken on an average of 5.24 adults and 27.16 larvæ per bird. In bulk it amounted to 40.76 per cent of the stomach contents. One male had eaten 5 adults and 108 larvæ. A female had made away with 24 adults and 68 larvæ. A pair collected in a breeding marsh had taken, respectively, 12 adults and about 90 larvæ, and 2 adults and 100 larvæ. The records of a few others are 12 adults and 73 larvæ, 5 adults and 77 larvæ, 13 adults and 58 larvæ, 6 adults and 61 larvæ, and in each of two cases 6 adults and 60 larvæ.

Next in importance to the weevil came caterpillars, which composed 17.38 per cent of the food for June. Aquatic and ground beetles formed a little over 5 per cent each; flies (largely the larvæ of aquatic species) 4.29 per cent; and spiders 3 per cent. The vegetable portion (12.67 per cent) was largely grain.

In July one male devoured 2 adults and 10 larvæ of the weevil.

Summary.—While the adult redwing eats its largest amount of weevils (over 40 per cent) in June, its greatest worth as a weevil destroyer lies in the fact that it is among the earliest of the weevil-eating migrants, often preying on these insects when snow is still on the ground. The food habits of the young are also in the bird's favor.

WESTERN MEADOWLARK.

(*Sturnella neglecta*.)

The western meadowlark (Pl. II) is a familiar bird of the Great Basin, and judging from early records is becoming more numerous in Utah as time goes on. Being a resident the year round, it is a common visitor to alfalfa fields as soon as snow leaves, and is more frequently met during April and early May than later in the year.



WESTERN MEADOWLARK.

In April, 27 of these birds were collected, and the weevil, which was found to comprise one-sixth of their food, was present in all but seven. The insects taken were adults, and the average was 14.4 weevils per bird. One bird had taken 75 of these insects, another 60, and three others 51, 48, and 33, respectively.

Other animal food is important, as the largest single item was caterpillars, amounting to nearly 22 per cent. These insects were present in all but 6 of the 27 stomachs, and in several instances formed a considerable proportion of the food. In one 15 caterpillars formed three-fourths and in another an equal number composed about two-thirds of the stomach contents. Ground beetles, many of which were of the genus *Amara*, amounted to about one-eighth of the food. Hymenoptera, largely parasitic ichneumons, were eaten to the extent of 6.5 per cent, while weevils other than *Phytonomus*, scarabæid beetles, Hemiptera, and Diptera formed about 2 per cent each. Of the vegetable food (27.26 per cent) a considerable portion (15.89 per cent) was grain, while the remainder was weed seeds and a little rubbish.

During May an increased consumption of caterpillars appears to explain a decrease in the percentage of weevils. The larvæ, eaten on an average of 3.83 per bird, and adults at the rate of 7.58, totaled nearly 11 per cent of the bird's food. A male taken in May had destroyed the largest number of adults, 81 of the insects comprising 92 per cent of the stomach contents. Another had made away with over 70 larvæ and 32 adults, while a third ate 40 larvæ and 10 adults.

Caterpillars amounted to nearly a third of the month's food (31.66 per cent), occurring in all but seven of the stomachs collected, and frequently composing the major portion of the food. In one case a bird had destroyed at least 20 of these insects and in two others 16 and 15, respectively, were eaten. Ground beetles were found in all but 2 of the 29 stomachs and amounted to over a quarter of the food. In two cases over 20 of these beetles were found in the stomach. Among them were several of the genus *Calosoma*, doubtless beneficial, but on the other hand there were large numbers of several species of the genus *Amara*, which are injurious to vegetation. Orthoptera (grasshoppers and crickets) composed 6.83 per cent, Hemiptera and scarabæid beetles about 3 per cent each, and several other insects were present in small quantities. The vegetable element was materially less than in May, being only a little over 9 per cent, and about two-thirds of it was grain.

In June the meadowlark maintains about the same relation to the weevil as during the preceding month. There is, however, an increase in the proportion of larvæ eaten. Examination of 14 stomachs revealed an average of 4.78 adults and 11.93 larvæ per bird, which amounted to nearly an eighth of the food. One bird worthy of men-

tion had taken no less than 100 larvæ and 4 adults and another had eaten 44 larvæ and 27 adults. Other food items vary but little in their relative proportions from those of May. Caterpillars formed a little less than a third of the contents and ground beetles about a fourth. Hymenoptera, many of which were parasitic ichneumons, composed 6.5 per cent, spiders 4.7, and weevils of the genus *Sphenophorus* about 4 per cent. The vegetable element was of no importance.

By July the abundance of other insect food caused the meadowlark to greatly reduce the proportion of weevils taken. The insect was eaten by only one of five birds examined. This bird, a fully fledged young, had consumed 16 adults of the year's brood, which formed 22 per cent of its food, giving an average of 4.4 per cent for the material collected in this month. Ground beetles and grasshoppers were the most important of the other food items.

Summary.—As a weevil destroyer the western meadowlark renders its most valuable service during the early days of spring, when many breeding adults fall prey to its diligent search. Its fondness for ground beetles and caterpillars, especially cutworms, has a tendency to reduce the percentage of weevils eaten during the following months. The good it does in the destruction of caterpillars more than offsets the harm arising from the eating of ground beetles. As the latter are very abundant throughout alfalfa fields, and as many are of species of doubtful economic value, the bird should not be too severely judged on this score. Examinations show that the meadowlark, at least from April to July, is not a menace to grain in Utah. On the other hand, its being a resident the year round makes it a valuable asset as a destroyer of hibernating insects, especially the alfalfa weevil.

BULLOCK'S ORIOLE.

(*Icterus bullocki*.)

Bullock's oriole secures much of its food from trees, caterpillars being the largest single item. Although the alfalfa weevil in all its stages is found most frequently on or near the ground, it was present in each of seven stomachs collected. Two birds taken in June had fed on it to the extent of 8½ per cent of their food, while in the following month it formed nearly twice that amount. One bird collected in July had eaten no less than 21 adults, equaling 30 per cent of its food. No larvæ were taken by these birds even though this form of the insect was in great abundance, so that the adults may have been captured either on the wing or upon the branches of trees which had intercepted their flight.

Of other animal food caterpillars are most important, and they occurred in four of the seven stomachs. One bird had fed almost

exclusively on these insects, there being only a trace of an alfalfa weevil. In bulk caterpillars formed over a third of the food during May and June. Hymenoptera, in the form of wild bees and ants, composed about a fourth of the contents of five stomachs. Vegetable food entirely of grain, which was probably waste, occurred in three of the stomachs collected in July, and formed about a fifth of the food for the month.

In spite of the accusation that Bullock's oriole injures peas and small fruit, its good qualities outweigh its harmful traits. It already has a favorable record as an insect destroyer, but we may now add the alfalfa weevil to the list of noxious forms eaten by this bird.

BREWER'S BLACKBIRD.

(*Euphagus cyanocephalus*.)

Brewer's, or the white-eyed blackbird (Pl. III), as it is commonly known in Utah, is the most abundant blackbird of the State. It is very evenly distributed throughout the Salt Lake and the Weber valleys. At a point east of Hoytsville a large tract of irrigated land, much of which is given up to alfalfa, lies rather isolated from the river valley proper and at an altitude of several hundred feet above it. Brewer's blackbirds nested abundantly at the lower level, and as soon as nestlings were hatched the parents began making regular trips to the badly infested fields above, adult birds being observed several times traveling considerably over half a mile between the alfalfa and the nest. Another colony made trips of about a third of a mile from their nests in the sagebrush to a portion of a field which was particularly badly infested. Later, parent birds brought their families to the infested fields, where, in flocks of 15 to 20, they spent the entire day.

Nestling and juvenile birds.—Under this head are included young birds of any age, from the nestling of a day or two to the fully fledged bird. Of 125 stomachs examined, 78 were for the month of June, 45 for July, and 2 for August.

In June the weevil formed 20.14 per cent of the stomach contents and was eaten by 60 of the 78 birds. Together these birds had caused the destruction of 231 adults and 904 larvæ, an average of 2.96 adults and 11.59 larvæ per bird. Though the weevil does not occur in such large quantities in this series as in those collected later, the following records are noteworthy: A fully fledged young bird had eaten from 45 to 50 adults and no less than 60 larvæ, comprising 87 per cent of the stomach contents. Another had taken from 15 to 20 adults and 60 larvæ. Sixty-four larvæ were found in the stomach of a nestling three or four days old, while four other nestlings had eaten, respectively, about 40 adults, 40 larvæ, 37 larvæ, and 31 larvæ and 1 adult.

The animal portion of the food of the young Brewer's blackbird at this time of the year is of economic importance and amounts to nearly 94 per cent. Conspicuous are caterpillars (mostly cutworms), which totaled 34.57 per cent, or over a third of the stomach contents. These insects, abundant in many fields and doubtless doing considerable injury, together with adult Lepidoptera, occurred in 59 of the 78 stomachs, in several cases amounting to over 90 per cent of the food. Ground beetles (*Carabidæ*) amounted to 11.45 per cent. While these beetles, as a family, are considered beneficial, being mainly predaceous, there are some which injure vegetation. This is especially true of the genus *Amara*, which made up the greater portion of this part of the food. Spiders were eaten freely by the nestlings and constituted 9.37 per cent of the food. Flies amounted to 7.34 per cent, while the remaining animal food was divided in small quantities among insects of several orders.

The vegetable food is of little importance at this time of the year, both from its character and relatively small proportion (6.08 per cent). Over three-fourths was of rubbish, which testifies to the voracious temperament of the young, while weeds and a little grain formed the rest.

The young Brewer's blackbirds obtained in July were fully fledged and were out of the nest picking up much of their own food. Of 45 birds only 2 had failed to eat the weevil, and in the remaining stomachs it amounted to 25.47 per cent of the food. An average of 11.47 adults, 0.24 pupa, and 25.53 larvæ, or over 37 weevils in one stage or another for every bird, was the record made by these juvenals. A few cases will illustrate the importance of these birds as weevil destroyers. One had eaten 229 larvæ, 7 pupæ, and 20 adults; another made away with 140 larvæ and 6 adults, and the record of a third was 4 adults and 150 larvæ. The abundance of adult weevils of the year's brood in the middle of July is indicated by the stomach of a young blackbird, which contained 95 insects in this stage. Another had captured 10 adults, 1 pupa, and 126 larvæ. Other interesting records are as follows: 94 adults; 1 adult and 60 larvæ; 26 adults and 45 larvæ; 21 adults and 35 larvæ; 3 pupæ and 63 larvæ; 3 adults and 50 larvæ; and 5 adults and 52 larvæ.

The weevil composed about one-third of the animal food during this period, which in turn amounted to 77.8 per cent of the total contents. Of other animal food Lepidoptera, mostly caterpillars, formed 13.18 per cent, a little less than two-fifths of the amount taken in June. Hymenoptera, many of which were parasitic, made up 11.29 per cent. Hemiptera, the bulk of which was composed of the small cicada, *Platypedia putnami*, formed 10.11 per cent. Ground beetles totaled 8.67, while the remaining portion was divided in small quantities under several heads.



BREWER'S BLACKBIRD.

The vegetable food, amounting to 22.2 per cent, becomes important in this month, as nearly two-thirds was of grain, mostly wheat, the rest consisting of weeds and rubbish.

By August most of these blackbirds had forsaken the alfalfa fields and were paying attention to grain. Such animal food as they needed was amply supplied in the season's crop of grasshoppers. Two stomachs secured are too few for accurate deductions, but both contained adult weevils, 25 and 12 respectively averaging 13 per cent of the contents. Grasshoppers made up 38.5 per cent, while the vegetable element, all of which was grain, amounted to 43.5 per cent.

Field observation and analysis of material collected indicate that the young of Brewer's blackbird hold a very high place among the enemies of the weevil. While the stomach contents may not show so high a percentage as in some other species, the size and voracious nature of the bird means that a large quantity of food is consumed. The other elements of its animal food also are highly in its favor.

Adults.—In the season of 1912 Brewer's blackbirds did not become abundant before the first of May. Only two adults were secured in April, one of which had eaten a single weevil. The other, taken in a cattle corral during a snow storm, had eaten nothing but grain.

In May 45 stomachs were collected, some of which contained surprisingly large numbers of these insects. Only four of the birds examined had failed to partake of this food, and its bulk amounted to 16.85 per cent of the stomach contents. The advancement in the life cycle of the weevil in the season of 1911 over that of 1912 is readily shown by this material. The 11 birds taken in the former year averaged 6.64 adults and 50.09 larvæ apiece, while those of 1912 had taken no larvæ whatever but had eaten 10.76 breeding adults apiece. A female collected in May, 1911, had eaten 25 adults and 246 larvæ, comprising 89 per cent of the food. This same bird also had eaten a grasshopper, a cricket, a caterpillar, and a clover-root curculio (*Sitones hispidulus*). A male taken in the same month had consumed no less than 10 adults and 200 larvæ, equaling 97 per cent of the food, while another had eaten 6 adults and 105 larvæ. While the material of 1912 did not reveal such large numbers, the work was confined entirely to the destruction of breeding adults. The highest number taken in May of the latter year was 50 adults. One bird had eaten 33, while five others had taken over 20 individuals apiece.

Caterpillars, with a percentage of 15.67, were the most important of other animal foods. Hemiptera, the greater part of which was the small cicada, *Platypedia putnami*, and carabid beetles, with the genus *Amara* predominating, composed about 6½ per cent each. Orthoptera, Hymenoptera, and Diptera about equally divided the balance of the animal food. The vegetable contents, amounting to 34.11 per cent, was largely grain, much of which doubtless was waste.

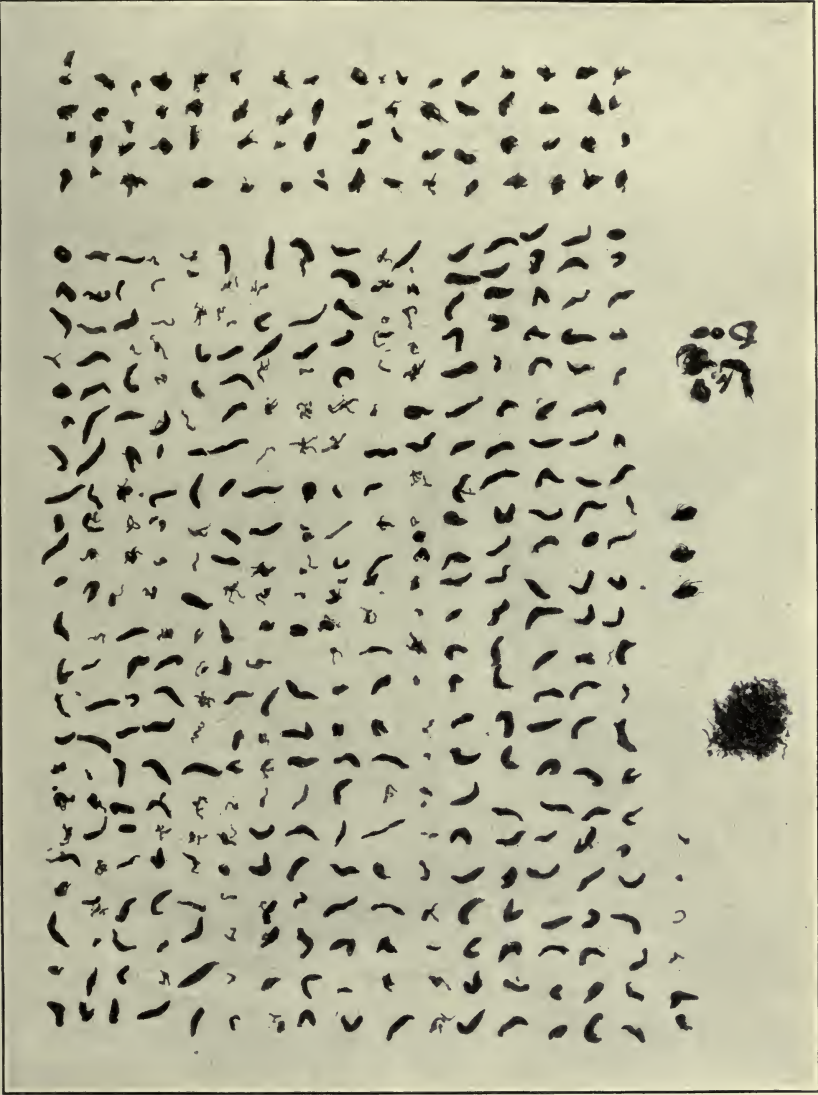
Adult blackbirds consume the largest proportion of alfalfa weevils in June, when the insect comprises nearly a third (32.70 per cent) of the food. Among the 99 stomachs examined are to be found records of the most remarkable work done by this bird. Only four had failed to eat the insect. The 99 birds together had made away with 580 adults, 68 pupæ, and 4,406 larvæ, averaging 6.4 adults, 0.7 pupa, and 48.9 larvæ, or 56 individuals per bird. Though this bird has a strong liking for insects of larger size, as cutworms and beetles of various kinds, the weevil formed the greater portion of the contents of many stomachs. In 11 cases it amounted to 90 per cent or more of the food.

A female secured from a post-breeding flock had devoured the largest number of weevils recorded for any individual bird—374 larvæ, 65 pupæ, and 3 adult weevils, a total of 442 individuals, comprising 96 per cent of the stomach contents. (See Pl. IV.) It also had eaten the larvæ of an aquatic beetle, a caterpillar, a dipterous larva, a nymph of a tree hopper (*Membracidæ*), two spiders, and a little rubbish, including a seed of filaree. Three birds had eaten, respectively, 281 larvæ, 268 larvæ and 6 adults, and 240 larvæ and 17 adults. In each case the weevil comprised 90 per cent of the food. Another had eaten 212 larvæ and 4 adults. In each of 14 other birds the combined number of larvæ, pupæ, and adults amounted to over 100, noteworthy among which was one containing 1 adult and 190 larvæ; another with 3 adults and 170 larvæ; and a third with 14 adults and over 140 larvæ.

Besides the weevils eaten during this month (32.7 per cent) the adult birds had taken nearly an equal quantity (27.83 per cent) of caterpillars. In seven stomachs this item made up over 90 per cent, while in one it formed the entire contents, the bird having eaten about 23 of these insects. Carabid beetles, Hemiptera, Orthoptera, and spiders formed the bulk of the remainder. The vegetable food, amounting to but little more than 5 per cent, was unimportant, as much was rubbish.

In July the depredations of these birds on the weevil are confined almost wholly to feeding on the adults of the year, which by this time are out in great numbers, especially in the vicinity of haystacks and along ditch banks, where they early seek places of hibernation. In one favorite resort of these birds about the base of a recently constructed stack, so many adult insects had fallen from the hay while the stack was being built that a brush of the hand in the debris at the base would disclose a squirming mass of hundreds which produced a distinctly audible "whir" in their scramble through the dry hay for new places of shelter.

During this month the weevil formed 20.26 per cent of the food, taken on an average of 12.45 adults and 1.79 larvæ per bird, and it was



STOMACH CONTENTS OF A BREWER'S BLACKBIRD.

[This individual had consumed the largest number of alfalfa weevils recorded for any bird—a total of 374 larvae, 65 pupae, and 3 adults, which comprised 96 per cent of the food.]

found in all but one of the stomachs. The highest number taken by any bird was 40 adults and 51 larvæ. This single stomach contained almost all the larvæ recorded for the adult Brewer's blackbird in July, which may be explained by the lateness of the season in the Weber Valley where it was collected. The contents of stomachs taken at this time in the upper valley corresponded to those taken three or four weeks previously in the vicinity of Salt Lake. Another bird had eaten 60 adults, while a third had taken 40. Eight birds collected in 1911 well show the character of the food when the weevil begins to disappear. Of the entire food 5.75 per cent was weevil while 91.5 was grasshoppers. Though much grain was being harvested in this region none was eaten by these birds.

Of animal food other than the weevil, grasshoppers are conspicuous, amounting to 27.2 per cent of the month's food. Caterpillars, ground beetles, and Hymenoptera, many of which were wild bees, comprised a little less than 10 per cent each. The rest of the animal food was divided in small quantities among several items of little economic importance. Of the vegetable portion (11.52 per cent), much was grain, the bulk of which was taken from the ripened crop.

Summary.—Brewer's blackbird, both old and young, is working for the best interests of the Utah farmer and in spring and summer is among the most effective bird enemies of the weevil. The adults appear to take slightly greater quantities of these insects than do the young, whose preference is for cutworms. Late in the season a marked liking for grasshoppers on the part of the old birds is also to their credit. About one-fifth of the food of both old and young during May, June, and July consists of weevils.

This bird is seldom shot or otherwise molested in Utah, where its economic worth is now fully appreciated, it having recently been afforded legal protection.

HOUSE FINCH.

(*Carpodacus mexicanus frontalis*.)

In Utah the house finch is probably the least insectivorous of all the finches, and in California has been much criticised because of its vegetarian habits. Primarily a seed-eating bird, it is true to its normal habits in Utah.

Nine of these birds were examined, but only two had eaten the weevil, the larval form in each case. One had taken two and the other three. Caterpillars, the only other animal food eaten, occurred in one stomach and composed about 15 per cent of the contents. The vegetable portion of the food consisted of weed seeds, of which three species were identified: Dandelion (*Taxaracum taxaracum*), shepherd's purse (*Capsella bursa-pastoris*), and smartweed (*Polygonum hydropiper*). Parts of other seeds were present, but, as this bird

is especially adept at hulling even the hardest and smallest of seeds, the partly digested embryos gave no clue as to their identity.

The house finch may render some service in checking the increase of the weevil by destroying adults early in the season, but owing to its almost exclusively vegetarian diet this must be small. Whatever worth this species has lies in its consumption of weed seeds.

PINE SISKIN.

(*Spinus pinus*.)

The stomach of the only pine siskin examined contained traces of an adult alfalfa weevil, but from what is known of its food habits in other parts of its range, this bird can not be regarded as important as a weevil destroyer. It is primarily a seed eater, and its animal food is confined mainly to such forms as plant lice and scale insects.

WESTERN VESPER SPARROW.

(*Poæcetes gramineus confinis*.)

The western vesper sparrow arrives in the Salt Lake Valley in March, when, during cold, blustery days, it may be found often in parties of three to six flitting about weed patches, usually not far from the protecting cover of a creek bottom. Later in the season it is a common breeder in the sagebrush areas adjacent to cultivated fields, and from here it makes regular trips to alfalfa fields in search of the weevil.

In April, 16 of these birds were collected in alfalfa fields. All but three had fed on adult weevils, which amounted to about a twelfth of the food. The small size of the stomachs means that in numbers the weevil will be limited. An average of a little less than two adult weevils per bird was maintained for this month, while eight weevils is the highest record of a single bird.

Other investigators have shown that the food of this bird varies from wholly vegetarian in midwinter to upward of 90 per cent animal during summer. In Utah insect life began to form an appreciable portion of the food in April, and amounted to a little less than a quarter of the stomach contents. A third of this was the alfalfa weevil. Of the other items the clover-root curculio (*Sitones* sp.) occurred frequently and totaled about 4 per cent of the contents. Fourteen of these were found in one stomach. Dung beetles (*Aphodius*) formed about an equal amount, while the remaining animal food was divided in small quantities under several heads. Of the vegetable food (76 per cent) about 19 per cent was grain and 57 per cent weed seeds. The latter element was present in all but one of the stomachs and in four instances formed practically the entire con-

tents. Among the weed seeds were those of filaree (*Erodium cicutarium*), sunflower (*Helianthus* sp.), pigweed (*Amaranthus retroflexus* and *A. blitoides*), cockle (*Vaccaria vaccaria*), smartweed (*Polygonum* spp.), panic grass (*Panicum* sp.), and brome grass (*Bromus* sp.).

Four vesper sparrows were collected in May, three of which had eaten the weevil, the fourth having been secured in a wooded ravine some distance from the nearest field. The weevil formed nearly 40 per cent of the stomach contents of the four, with an average of about three adults and six larvæ per bird. In the remaining food, caterpillars (8.25 per cent), grain (11 per cent), and weed seeds (42 per cent) predominate.

Examination of a series of 19 stomachs in June shows that these fringilline birds are decidedly insectivorous during the breeding season. Every one had fed on the weevil, and in 4 it amounted to over 95 per cent of the food, while the average for the month was nearly 60 per cent. As many birds were collected at a time when the larvæ were most abundant, this form of the insect appeared in large numbers in some stomachs. An average of 3.8 adults and over 24 larvæ per bird was recorded. One bird had eaten 2 adults and 60 larvæ, another 6 adults and 55 larvæ, and a third 1 adult and 50 larvæ. The weevil contents of several others are as follows: 5 or 6 adults and about 45 larvæ; 2 adults and 45 larvæ; 1 adult and 40 larvæ; 7 adults and 28 larvæ; and 10 adults and 21 larvæ.

Of the other animal food items Hemiptera, composed chiefly of the small cicada, *Platypedia putnami*, so abundant in the oak chaparral of the foothills at this time of the year, formed the next largest portion (7.79 per cent). Clover root curculios (*Sitones*), "bill bugs" (*Sphenophorus*), caterpillars, parasitic Hymenoptera, and grasshoppers follow in the order named. The vegetable portion (10.63 per cent) is divided between grain and the weed seeds previously mentioned.

For the month of July a larger series of stomachs (44) affords added evidence of the remarkable work of these sparrows as destroyers of the weevil. Only one had failed to feed on the insect. There was an increase in the average number of adults taken (5.36) and a decrease in the number of larvæ (18.43) as compared with the preceding month, because of the presence of more adults of the year's brood during July. Animal food comprised 73.02 per cent of the contents, 52.09 per cent being weevils. One bird had eaten 65 larvæ and 2 adults and was carrying 17 larvæ of the weevil in her bill for her young. Another had taken 46 larvæ and 22 adults. The stomach of a full-fledged sparrow collected in July, and still being fed by its parents, contained 45 larvæ and 8 adults. Eighteen other birds had

eaten 25 or more weevils in one stage or another, and 3 had also eaten a few pupæ.

Of the remaining items of animal food, caterpillars (5.59 per cent), ground beetles (4.2), and Hemiptera (mainly the small cicada, *Platypedia putnami*) (4.09) were most conspicuous. Weed seeds again were prominent, amounting to 22.3 per cent, while grain formed about $4\frac{1}{2}$ per cent.

Summary.—Though the individual vesper sparrow is unable to consume as many of the insects in question as some of his larger and more voracious neighbors, as Brewer's blackbird or the robin, its economic relation to the weevil is nevertheless important. During June and July it subsists on the pest to the extent of over half of its food, while from a fifth to a third more is composed of other equally injurious insects, together with weed seeds. The grain eaten is doubtless mainly waste. These birds, whose natural home is in the dry sagebrush areas, probably are just beginning to discover the food supply obtainable in alfalfa fields. As they become more accustomed to visiting the alfalfa, we may expect them to render still greater service in the suppression of the pest.

WESTERN SAVANNAH SPARROW.

(*Passerculus sandwichensis alaudinus*.)

The western savannah sparrow is to the average person an inconspicuous individual in the bird life of Utah, even though fairly abundant in many sections. It is frequently met in the Salt Lake Valley, but is much more common in the valley of the Weber, where in some fields it is the most abundant of the sparrows.

In May, 1911, seven savannah sparrows were obtained. All but one had fed on the weevil, and this pest composed 72.42 per cent of the stomach contents. The larvæ apparently were preferred, for, although adult weevils were common, they occurred at an average of only a little over one per bird, while the larval form was found at the rate of 21 in every stomach. One had eaten no less than 61 of the green worms, the highest number recorded for the species.

The remaining food, which, save a mere trace of rubbish, was entirely animal in character, verifies the claim that this bird is one of the most highly insectivorous of sparrows, and that "they take equal rank in this regard with such notable insect destroyers as the catbird, robin, and bluebird".¹ The food other than weevil was decidedly in the bird's favor as a large part was caterpillars, fly larvæ, plant lice, and some unidentified coleopterous larvæ.

¹ Judd, S. D., The Relations of Sparrows to Agriculture, Bull. 15, Biol. Survey, U. S. Dept. of Agr., 1901.

Five stomachs of this species were available for June, and in every one the weevil was found. A large quantity of caterpillars in two stomachs reduced the percentage of weevils taken, but the results show that in this month the savannah sparrow is continuing the good work started earlier in the season. The weevil composed 37.4 per cent of the stomach contents and an average of a little over 1 adult and 11 larvæ were taken by each bird. The other food, again almost wholly animal, contained, besides nearly 30 per cent of caterpillars, a quantity of spiders, estimated at a little over a fifth of the food. This latter item was present in four of the five birds and was practically the only food which could not be considered in the bird's favor.

Nine stomachs collected in July reveal in a most striking manner the worth of this insectivorous sparrow as an enemy of the weevil. All of these birds had eaten the insect, and in six instances it amounted to 90 per cent or upward of the food, the average consumption for the month being 80 per cent. These birds were collected in the Weber Valley, where larvæ were very abundant, and they fed on the insect at the rate of $16\frac{1}{2}$ larvæ and a little less than 2 adults per bird. The highest number eaten by a single bird was 26 larvæ and 1 adult.

Of the remaining food Hemiptera formed the largest portion (7.67 per cent). Included here are many small bugs of the genus *Corizus*. Caterpillars composed about $5\frac{1}{2}$ per cent. The vegetable portion, 2.22 per cent, was entirely weed seeds.

Summary.—Of the native sparrows of Utah probably none can equal the western savannah as a destroyer of the alfalfa weevil, unless, under favorable conditions, it may be the western chipping or Brewer's sparrow. It not only appears to be the most highly insectivorous of the fringilline birds in this area, but also includes in this diet more than an ordinary share of weevils. During May, June, and July this insect forms from a half to two-thirds of its food, sufficient evidence in itself to induce every farmer to become familiar with the savannah sparrow and encourage its presence about infested fields.

WESTERN LARK SPARROW.

(*Chondestes grammacus strigatus*.)

The lark sparrow, one of the most robust and conspicuously marked of western sparrows, is found in abundance throughout the Salt Lake and Weber Valleys, and occurs in approximately the same numbers wherever found. It is frequently seen about alfalfa fields, and is one of the effective bird enemies of the weevil.

It is common by the first of May, and the 14 birds collected in this month show that they already were capturing breeding adults.

Weevils composed nearly 24 per cent of the lark sparrow's food and were present in all but one of the stomachs examined. With the exception of one bird collected in the season of 1911 all had been feeding on the adult form of the insect, it being eaten at an average of over five apiece. Fifteen was the highest number taken by a single bird.

About half of the remaining animal food (7.3 per cent) was caterpillars, with click beetles (Elateridæ) and clover-root curculios (*Sitones* sp.) next in order. The vegetable portion, 62.5 per cent, was divided between grain and weed seeds. The former, composing about two-thirds of it, may, to a certain extent, have been picked up from newly sown fields, but no serious complaints have been made against this bird.

Six lark sparrows collected in June show a considerable increase in the amount of weevils eaten (31.2 per cent). The insect was present in each of the stomachs at an average of about 7 adults and 7 larvæ per bird. In one the 4 adults and 30 larvæ present formed 77 per cent of the food. Caterpillars and grasshoppers, totaling about 14 per cent each, are the most important of other animal food items. The clover-root curculio (*Sitones* sp.), which is abundant in many sections, was present in small numbers in four of the six stomachs. The vegetable portion was again characterized by waste grain, which composed nearly a third of the contents.

In July the insect formed nearly 30 per cent of the food and was eaten by each of the 11 sparrows secured at the average rate of about 7 adults and 7 larvæ, the same as for the preceding month. The best record for the month and for the species was 13 adults and 49 larvæ, while the bill of the bird eating them contained 6 additional larvæ. Caterpillars, occurring in seven stomachs, were next in importance and composed 16 per cent of the remaining animal food. The vegetable element, which formed nearly half of the food, was, as in the two preceding months, noteworthy for its high proportion of grain (45.5 per cent).

A single bird collected in August had eaten several adults of the year's brood, amounting to 8 per cent of its food. The remaining portion of the stomach contents was entirely wheat.

Summary.—The claim that the lark sparrow is a greater lover of grain than most other native sparrows¹ is apparently substantiated by the writer's work in Utah. It is quite possible that some grain is secured from newly sown fields or from the ripening or shocked crop, but no noticeable losses have been attributed to this bird. As an effective enemy of the weevil the lark sparrow must not be over-

¹ Judd, S. D. Relation of Sparrows to Agriculture. Bull. 15, Biol. Survey, U. S. Dept. of Agr., 1901.

looked. Though its animal food is somewhat less than that of most of its relatives during the summer, in May, June, and July this bird showed a marked preference for the weevil. It was taken more frequently than any other food item, and formed about 57 per cent of the animal food.

WHITE-CROWNED SPARROW.

(*Zonotrichia leucophrys leucophrys.*)

The white-crowned sparrow is a common migrant throughout the Salt Lake Valley and breeds in the higher parks of the Wasatch. The single bird available for this investigation was secured in May, and its stomach contained the remains of one adult alfalfa weevil. Though not an extensive insect eater the white-crowned may assist in reducing the weevil during spring months.

WESTERN CHIPPING SPARROW.

(*Spizella passerina arizonæ.*)

Only eight stomachs of western chipping sparrows are available for examination. One each was taken in May and June, and six in July. Of these only one, a bird collected near Salt Lake City, in May, 1911, had failed to eat alfalfa weevils. This bird had fed almost exclusively on plant lice. The bird taken in June had eaten 38 of the weevil larvæ, composing 98 per cent of the food, while five lepidopterous eggs made up the balance. Each of the six birds collected in July had fed on the insect at an average rate of about 1 adult and 17 larvæ apiece. These composed 76.5 per cent of the monthly food, and in one instance comprised the entire contents of the stomach, 32 larvæ being needed to fill it. The stomach containing the smallest quantity (12 per cent) had three-fourths of its contents composed of weed seeds. Of two birds which were evidently feeding young, one had in its bill 6 larvæ of the weevil, and the other had 8 larvæ and a caterpillar. Of animal food other than weevils, bugs and spiders were most prominent and the vegetable element of 12.6 per cent was entirely weed seeds.

Too few chipping sparrows were examined to allow a general conclusion, but its habits apparently justify placing this bird on a par with its close relative, Brewer's sparrow, in its relation to the alfalfa weevil. The larvæ of the weevil are suitable both in size and availability as food for a bird of this character. Examination of a larger series of stomachs probably would show that the chipping sparrow feeds on the weevil to the extent of upward of four-fifths of its food during the months of the greatest abundance of the insect.

BREWER'S SPARROW.

(Spizella breweri.)

Brewer's sparrow, or the little sagebrush chippy, as it is sometimes called, has, like several of its close relatives, learned within the past four or five years that alfalfa fields afford an excellent supply of animal food. In some localities during May and June there is little to choose between the merits of this bird and the savannah sparrow as weevil destroyers.

Brewer's sparrow does not become abundant until May, and in this month 14 were obtained. Half of these were taken in the season of 1911 when the weevil larvæ were well advanced. These insects composed 43.43 per cent of the food, and occurred in all but one of the stomachs, averaging 2.2 adults and 6.9 larvæ per bird. Twenty-four larvæ was the largest number present in any one stomach.

The stomach of the bird which had not fed on the weevil was nine-tenths full of plant lice, a food item which occurred in 7 of the 14 stomachs, and amounted to over 38 per cent of the food. In one case these insects composed practically the entire contents (97 per cent). Caterpillars were present in five stomachs, forming 7.7 per cent. Spiders and miscellaneous beetles were estimated at about 3 per cent each, and the remaining animal food was of small quantities under several heads. The vegetable portion (1.1 per cent) was entirely weed seeds.

Each of the 15 Brewer's sparrows collected in June had fed on the weevil. Three were nestlings, but their food differed but little from that of adults. In only one instance did the weevil amount to less than a fourth of the food, while in one it composed the entire stomach contents, 25 larvæ being present. Three others were examined in which the weevil formed over 95 per cent of the food, these birds having eaten 17 larvæ, 19 larvæ and 1 adult, and 28 larvæ, respectively. The average of 0.4 adult and 15.3 larvæ eaten by these birds totaled nearly two-thirds (64.6 per cent) of the food.

Caterpillars superseded plant lice as the next most important food during this month, forming 14.5 per cent of the stomach contents, while the latter amounted to only about half that quantity. Spiders, the only other important component of the animal food, were eaten freely by four birds, giving a percentage of 6.13 for the month. Merely a trace of weed seeds was present.

In July 13 of the 17 Brewer's sparrows collected had fed on the weevil, but a decrease in the bulk was noted, it composing 44.8 per cent of the stomach contents as compared with 64.6 per cent for June. There was a slight increase in the number of adults eaten (0.6) and a corresponding decrease in the larvæ (11.8). The highest number of larvæ recorded for an individual of this species is 45. These com-

posed approximately 77 per cent of the food of this sparrow while the remains of a caterpillar and two pupæ of a moth added 20 per cent. One bird ate 3 adults and 18 larvæ, which comprised 94 per cent of the stomach contents, and it also carried 9 larvæ in its bill.

The other July food indicates a tendency toward a more vegetarian diet. About a fifth of the food was vegetable, while most important among the animal food items other than alfalfa weevils were caterpillars (11.9 per cent), Hemiptera, many of which were leaf hoppers (Jassidæ) (9.71), and spiders (2.12). The vegetable element was made up almost exclusively of weed seeds, dandelion and seeds of an unidentified grass occurring most frequently.

Summary.—Brewer's sparrow must be ranked among the most effective enemies of the weevil. During the height of the weevil season it subsists to the extent of over half its food on this pest. Other insects equally injurious, as plant lice and caterpillars, also fall prey to this bird. In the summer months upward of 90 per cent of its food consists of injurious insects and the seeds of weeds. The remaining tenth is composed of insects that are either neutral in their economic relations or indirectly beneficial to man. The amount of grain taken is insignificant.

DESERT SONG SPARROW.

(*Melospiza melodia fallax*.)

The desert song sparrow is one of the commonest of the native sparrows of Utah during the early spring months, when it may be found in the thickets along streams or irrigating ditches. Considerable numbers also pass the winter in favorable spots, which enables them to come in contact with hibernating adult weevils.

All but 2 of 11 birds collected in April had fed on the insect. Another bird whose stomach was too nearly empty to be of use in this investigation also had eaten weevils. In no case did more than 4 individuals appear in one stomach. In bulk they formed 7.35 per cent of the food.

Of other animal food the aquatic larvæ of stratiomyid flies composed the major portion, nearly 12 per cent. Caterpillars were present in two stomachs (7.27 per cent) and among other items which occurred in smaller quantities were spiders (5.45), dung beetles (*Aphodius*) (3.9), ground beetles (3.18), click beetles (2.72), and aquatic beetles (2.63). The vegetable portion was largely the seeds of weeds (31.18 per cent), among which were those of amaranth, pigweed, sunflower, ragweed, brome grass, and a sedge. Two birds had fed extensively on wheat, which brought the average for the month up to 16.45 per cent.

Two song sparrows collected in May had been doing good work on the weevil. In one, 5 larvæ and 1 adult formed 24 per cent of the food, while in the other 22 larvæ and 2 adults comprised about three-fourths of the stomach contents. Besides this the former had eaten a cricket and a large cutworm, and the latter two click beetles and a spider.

A single bird taken in June had destroyed 29 larvæ, which made up nearly two-thirds of the food; the rest of the contents included three click beetles, a caterpillar, three plant lice, two ants, a snail, seeds of three weeds, and a little grain.

As the song sparrow spends much of its time in early spring in localities selected by the weevil as places of hibernation, it must be looked upon as a valuable agent in the control of the pest. It also aids in the reduction of the number of larvæ later in the season. This bird, along with several other native sparrows, is frequently confused with the English sparrow, especially by the small boy engaged in killing the latter for bounty. This not only is one of the most potent arguments against a bounty system, but also reveals the need on the part of people generally of a more intimate knowledge of the appearance and economic value of insectivorous birds.

LINCOLN'S SPARROW.

(*Melospiza lincolni lincolni*.)

Lincoln's sparrow is a fairly common migrant in Utah, and was found in considerable numbers during April, often in company with its relative the song sparrow. Being almost entirely terrestrial in its feeding, it is seldom seen by the casual observer.

This bird renders its best service as an enemy of the weevil in destroying hibernating adults hidden in the localities it frequents in early spring. Each of three birds examined had fed on the insect, and it composed $8\frac{2}{3}$ per cent of the food. Adult insects were taken in every case and were eaten at an average of about two per bird. Among the remaining food were found the clover-root curculio (*Sitones* sp.), crane flies, aquatic beetles, and weed seeds.

SPURRED TOWHEE.

(*Pipilo maculatus montanus*.)

The spurred towhee is most common over the oak-covered foothills of the Wasatch, and wherever this growth extends to the close proximity of alfalfa fields it may be considered an enemy of the weevil. As it is a resident species and terrestrial in habits it comes in touch with hibernating adults. Only two of these birds were collected, both in April, and each had fed on the insect. One had eaten but a single adult, amounting to 1 per cent of its food, and the other had taken

at least 8, which comprised about an eighth of the stomach contents. Other food items highly in the bird's favor were seeds of brome grass, ragweed, and filaree; also the remains of click beetles, the parents of wireworms, were present in both stomachs.

As other investigations¹ have shown that the various subspecific forms of this towhee are, in other localities, of benefit to man, and since in Utah it was found to feed on the weevil, there is every reason for its conservation. Its greatest service as a weevil destroyer is rendered in the colder months.

GREEN-TAILED TOWHEE.

(*Oreospiza chlorura*.)

The older name of canyon finch is one that fittingly describes the habitat of the green-tailed towhee. Among the oak chaparral of the lower altitudes of the Wasatch this bird is often met, and as it frequently follows down the course of a mountain stream it may be found about the borders of alfalfa fields. This was observed many times in the valley of the Weber, but at no point in the irrigated areas of the Salt Lake Valley can the bird be called abundant. Six of the eight examined had fed on the weevil. One taken in May had eaten four or five adults (35 per cent) as well as a ground beetle, three darkling beetles, a hymenopteran, and a stinkbug. Another taken in June had the contents of its stomach too finely digested for accurately estimating percentages, but fragments of alfalfa weevils were recognized. Each of the other four towhees collected in June had fed on the insect, which formed an average of 57.5 per cent of the monthly food. One had destroyed 27 larvæ and 3 adults. Ground beetles, darkling beetles, Hymenoptera, and bugs were the more important of the other animal food items, while of the vegetable food weed seeds predominated.

This towhee's warfare on the weevil is conducted only in comparatively few fields located at favorable points in higher altitudes. Little though this may be, this bird should be carefully protected, especially since in other directions it is working for the best interests of the farmer.

BLACK-HEADED GROSBEEK.

(*Zamelodia melanocephala*.)

The black-headed grosbeak is a fairly common and rather evenly distributed species in the Salt Lake Valley, and is most frequently seen about the upper branches of shady cottonwoods.

¹ Beal, F. E. L., Birds of California. Bull. 34, Part II. Biol. Survey, U. S. Dept. of Agr., 1910.

Investigation of the food habits of eight of these birds, four of which were young, revealed that every one had fed on the weevil, though in some instances it amounted to only 1 per cent of the food. An adult taken in May had, besides one weevil and another beetle, the pulp and skin of an unidentified fruit. Three adult grosbeaks collected in June had subsisted on the weevil to the extent of 16, 1, and 95 per cent of their food, respectively. The first of these had eaten no less than 35 larvæ and 7 adult weevils; the second, 3 adults; and the third, 83 larvæ and 8 adults. Along with these were found remains of ground beetles, weevils other than *Phytonomus*, stinkbugs (Pentatomidæ), the small cicada (*Platypedia*), the seeds of weeds, and fruit of a hawthorn (*Crataegus*).

The four young grosbeaks were of the same brood, nestlings about two-thirds fledged. Their nest was located in a creek bottom flanked on one side by a badly infested alfalfa field. The consumption of weevils by these birds was at an average of 3 per cent for the brood, while 7 adults was the largest number taken by a single bird. The presence in the immediate neighborhood of large numbers of the small cicada, *Platypedia putnami*, may account for the relatively small proportion of weevils taken. The former insect occurred in each of the stomachs and averaged 88.5 per cent of the food. These young birds had also eaten small quantities of ground beetles, clover-root weevils, carrion beetles (*Silpha*), and a click beetle.

The number of stomachs available for this investigation is too limited to say how great is the work of the black-headed grosbeak as an enemy of the weevil, but the fact that each of the eight birds examined had fed on the insect indicates that it is picked up whenever found. Other investigations¹ have shown that with the exception of occasional depredations upon small fruit there is nothing objectionable in the food habits of this bird. When to its already favorable record we add the destruction of even a limited number of the alfalfa weevil, no doubt remains as to the economic, to say nothing of the esthetic, worth of this bird to the people of Utah.

LAZULI BUNTING.

(*Passerina amoena*.)

The lazuli bunting is frequently found about shrubbery along streams and on a few occasions was seen visiting the alfalfa in search of food. Only three stomachs were examined. One bird, taken in a wooded ravine some distance from the nearest irrigated fields, had failed to feed on the insect. The contents of its stomach were entirely vegetable, consisting of at least 60 seeds of *Montia*.

¹McAtee, W. L., Food Habits of the Grosbeaks. Bull. 32, Biol. Survey, U. S. Dept. of Agr., 1908.

Two others had eaten the weevil, and in one of these 12 adults formed one-half of the contents while 5 adults and 29 larvæ in the stomach of the other composed 99 per cent of the food, a single seed of dandelion being the only other ingredient. The former of these had fed also on a cicada, a grasshopper, an ant, and a little grain. The lazuli bunting, aside from its esthetic value, is a bird of considerable economic importance. The products of the farm seldom enter into its diet, while among its customary food may be found the seeds of troublesome weeds and many noxious insects, including the alfalfa weevil.

CLIFF SWALLOW.

(*Petrochelidon lunifrons lunifrons*.)

With the exception of the rough-winged, the cliff swallow is the most abundant swallow in the territory covered by the present investigation. As enemies of the alfalfa weevil the most effective work of this and other swallows almost continuously on the wing is either at the time of the spring flight of the weevil or when the brood of the year takes wing later in the season.

Twenty stomachs of the cliff swallow were examined, three of which were of adults and the rest nestlings. The adults were collected early in June, when the birds were engaged in nest building and their stomachs contained 2, 6, and 8 adults, respectively, which formed about 12 per cent of the contents. Ground beetles composed over 40 per cent of the food. Besides these were found fairly large amounts of Hemiptera (bugs), Odonata (dragon flies), and aquatic, scarabæid, and other beetles.

In the stomachs of 17 nestlings collected later in the month the weevil formed but a part of 1 per cent of the contents, and was present in 7 of the 17 stomachs. In only one, however, did this insect occur in considerable numbers, that of a nestling about a week old which had been fed 21 adults. Another had eaten 5, and a third, 3.

As these birds were not far distant from extensive marshy areas, large quantities of the small aquatic beetle (*Helophorus lineatus*) were found in their stomachs. These had been eaten by each of the nestlings and formed about a sixth of their food. As many as 50 of these beetles were found in a single stomach. A small black ant occurred in each of the stomachs, in some cases in surprisingly large numbers, and in bulk it comprised a little over half of the young cliff swallows' food. The remains of flies of several species formed over a fourth of the stomach contents.

The work of all swallows upon the alfalfa weevil is confined to the two flight periods of the adult insect. During the earlier flight, when the life of the weevil is at its lowest ebb, any reduction of its num-

bers is of the utmost importance in suppressing the number of the season's brood. Though the cliff swallow does not arrive in Utah in abundant numbers much before the 10th of May many breeding alfalfa weevils may still fall as its prey. These birds feed on no product of the farm unless it is an occasional honey bee, but they include in their diet many of our most serious insect pests, noteworthy among which is the cotton-boll weevil in the Southern States.

BANK SWALLOW.

(*Riparia riparia*.)

The finding of two adult weevils in the stomach of a single bank swallow is the only evidence that this bird is among the enemies of the insect. Other elements in the food were numerous dung beetles (*Aphodius*) and several flies, including a syrphid.

ROUGH-WINGED SWALLOW.

(*Stelgidopteryx serripennis*.)

Over much of the alfalfa district of Utah the rough-winged is the most abundant of swallows. Nesting in banks of streams or railway cuts, they at times are in close proximity to infested fields.

Examination of twenty-one of these birds revealed the fact that the greatest consumption of weevils took place late in summer, when the year's brood had taken wing.

Of five birds collected in May, two had fed on the insect, which comprised 4 and 2 per cent, respectively, of their food. The remains of flies, some of which were of the genus *Bibio* (March flies), formed nearly two-thirds of the stomach contents, while small Hymenoptera and dung beetles (*Aphodius*) also figured prominently in the percentages.

During June only three of a series of eight had fed on the weevil, to an average extent of 1 per cent of the stomach contents for the month. Flies of various kinds were taken in considerable numbers and formed about three-fourths of the food. Small Hymenoptera were present in six of the stomachs.

In July the birds began to prey upon the flying adults of the year's brood. Six of the eight swallows examined had fed on the insect, which composed 23 per cent of their food. The weevils had been taken on the average of nearly 8 per bird, 18 being the highest number recorded from a single stomach. In this case it formed over a third of the contents, and in another 11 weevils made up nearly a half. Ants, found in each of the stomachs, amounted to over half of the swallow's food. Neuropterous insects were also detected in several cases.

No rough-wings were collected in August, but in all probability these birds continue to prey on the insect during late summer whenever a flight takes place.

The rough-wing probably is as effective an enemy of the weevil as the cliff swallow, but, like the latter, its work is limited to warm, fair days of spring and late summer. In addition to the good work of this bird upon this insect its economic status, based on other activities, is in its favor.

YELLOW WARBLER.

(*Dendroica aestiva aestiva*.)

The yellow warbler is the most common of breeding warblers throughout the Salt Lake Valley. Whenever its favorite nesting site of willows along the banks of streams and irrigating ditches occurs about the borders of alfalfa fields, this bird is brought in contact with the weevil.

Five birds were collected in June and two in July. Only those taken in the latter month were feeding on the weevil. One had eaten 11 larvæ and 1 adult, the other 6 larvæ. Besides, the latter had in its bill 3 weevil larvæ, a bug, and 9 flies. In bulk the weevil composed nearly a fourth of the food of the two.

The other yellow warblers had fed extensively on caterpillars, which were found in each of the stomachs and formed nearly 70 per cent of the food. One half-grown nestling had been fed exclusively on these insects. Small Hymenoptera, some of which were parasitic, were next in abundance, forming nearly a fifth of the contents.

Although abundant about the borders of alfalfa fields, yellow warblers were seldom observed dropping down to them in search of food. The upper branches of willows are their favorite resorts and apparently their food is largely secured from such places.

MACGILLIVRAY'S WARBLER.

(*Oporornis tolmici*.)

Listing Macgillivray's warbler as an enemy of the weevil is based on the examination of only one stomach. Two breeding adult weevils eaten in May formed about 2 per cent of the contents. There were also present the remains of a click beetle, a dung beetle, a flea beetle (*Systema* sp.), and a large amount of unidentified insect fragments.

LONG-TAILED CHAT.

(*Icteria virens longicauda*.)

Our knowledge of the long-tailed chat as a weevil destroyer is based on the examination of three stomachs. In two the insect was present, one containing a mere trace of an adult, and in the other 2 adults composed about 3 per cent of the food.

The chat's food habits are strikingly like some of the flycatchers. Hymenoptera form a conspicuous element in its diet, as do also flies and other forms which the bird may secure from its favorite haunt in the tree tops. One bird had eaten six wild bees, aggregating 94 per cent of the food, and another had fed on the small cicada (*Platypedia putnami*), which formed about two-thirds of the stomach contents.

As a check upon the weevil little can be expected from the long-tailed chat, because of its arboreal habits. Its food is of little economic importance, much being of a neutral character, while a certain proportion of beneficial insects appears to offset the good it does in the destruction of noxious forms. The inestimable value of its wonderful song, however, is alone sufficient reason for the most careful preservation of the species.

SAGE THRASHER.

(*Oreoscoptes montanus*.)

The sage thrasher, a bird of the arid regions, arrives in the Salt Lake Valley about the middle of March, and its rather weak song may then frequently be heard about the edges of alfalfa fields bordering on sagebrush areas.

Examination of 10 stomachs showed that the sage thrasher feeds on the weevil to a considerable extent. In bulk it formed about an eighth of the food and was present in seven of the stomachs. The best work appeared to be done in June, when the insect was eaten at the rate of about 3 adults and 6 larvæ per bird. One bird had eaten 3 adults and at least 34 larvæ, which composed 44 per cent of the stomach contents.

Ground beetles were present in all but two of the stomachs examined and formed about 30 per cent of the food in June and a lesser amount in April and July. These beetles and a trace of an ant formed the entire contents of one stomach. Darkling beetles of the genera *Blapstinus* and *Eleodes* also were frequently eaten, composing a fifth of the food. Hymenoptera, spiders, and caterpillars were other important ingredients. The only vegetable food was a quantity of currants found in one stomach.

The sage thrasher can not be regarded as a very effective enemy of the alfalfa weevil, except when alfalfa fields extend toward its native haunts among the sagebrush. Under ordinary conditions its food habits are strongly in the bird's favor, but occasional complaints have been made that it injures small fruits.

LONG-TAILED CHICKADEE.

(*Penthestes atricapillus septentrionalis*.)

The long-tailed chickadee was frequently met along the borders of alfalfa fields and in the shrubbery of creek bottoms in irrigated

sections. Being a resident all the year, in early spring it could be found searching diligently over the branches and trunks of cottonwoods or flitting through dense thickets of hawthorn or willows. In such environment it is quite possible for the chickadee to come in contact with hibernating weevils.

Six birds were collected in April, and the weevil was present in the stomachs of three. Two of these contained 2 adults apiece, while the third had 3, and this food amounted to about 3 per cent of the stomach contents.

Much of the food of these small birds was very finely divided and in some cases unidentifiable. In three of the six stomachs, however, large numbers of plant lice were detected. Small lepidopterous cocoons also were found.

Even though the amount of food consumed by one of these birds is small, there is reason to believe that the chickadees secure many of those adults which make their winter quarters in crevices in the bark of trees.

WESTERN ROBIN.

(*Planesticus migratorius propinquus*.)

The western robin is a resident of parts of the Salt Lake Valley the year round, but in the more exposed situations and in the higher valleys surrounding Salt Lake it is a migrant and summer breeder. In the lower valley it becomes very abundant in April and early May, while a month or two later, though still common, it is most frequently found in the shade of orchards or in truck-crop areas, where the more thoroughly watered ground assures it a constant supply of one of its favorite foods—earthworms. In the valley of the Weber the robin was an abundant breeder and a frequent visitor to the infested alfalfa fields.

Forty-five birds were collected in April, but four stomachs, being nearly empty, were not used in the computation. Three of the four stomachs discarded, however, showed traces of the weevil. Of the others, 28 contained the insects, adults in every case, which comprised a little over 14 per cent of the food. This material gave an average of 5.63 adult weevils per bird. The best individual work done by any robin in this month is credited to a male, which had captured no less than 56 of these insects. Another had eaten upward of 20.

Caterpillars, many of which were cutworms, were taken with almost as great avidity as the weevil, occurring in 27 stomachs, but the larger size of these insects resulted in a much higher percentage, 23.24. One stomach contained at least 90 young caterpillars. Click beetles (*Elateridæ*) and their larvæ, wireworms, were found in 18 stomachs and amounted to 11.10 per cent of the contents. One bird

had eaten no less than 5 adults and 40 larvæ of *Limonius occidentalis*. The other more important elements of the animal food were earthworms (8.68 per cent), flies (5.97), dung beetles (*Scarabæidæ*) (5.70), and ground beetles (3.97). Carrion, unassociated with bone fragments to denote its origin, was found in several stomachs. The rather careless feeding habits of this bird are attested by a large amount of rubbish in the food. This occurred in 23 stomachs and amounted to nearly 12 per cent of the bulk. A little grain (2.10 per cent) also was eaten.

For the month of May only four stomachs are available. Each contained the weevil, totaling 7.25 per cent of the food. No very large numbers of the insect were recorded, but this is attributed to the limited amount of material. The other food items maintained approximately the same relative proportions as in April.

During June a series of 17 stomachs was collected largely about Coalville, in the Weber Valley, where these birds bred in considerable numbers. The weevil, present in 10 stomachs, composed 23.77 per cent of the food, and was taken at an average of about 2 adults and 42 larvæ per bird. Two birds had eaten exceptionally large numbers of the insect. One destroyed 2 adults and 253 larvæ, and the other 3 adults and about 241 larvæ; the latter composed 80 per cent of the food. Two other noteworthy records were 1 adult and 75 larvæ, and 5 adults and 40 larvæ, respectively. Caterpillars, again a prominent part of the food, were present in all but three of the stomachs and amounted to nearly a fifth of the contents. Ground beetles, darkling beetles (*Eleodes*), carrion beetles (*Silpha*), and carrion were the other prominent animal food items. Rubbish, comprising the bulk of the vegetable element, amounted to more than a fourth of the contents.

Examination of 18 robins collected in July showed a falling off in the amount of weevils eaten. Eleven birds had fed on the insect at the rate of 4 adults and 13.8 larvæ per bird and to the extent of 9.39 per cent of the monthly sustenance. One stomach contained 2 adults and about 220 larvæ. Caterpillars, still a conspicuous element (37.72 per cent), occurred in 12 stomachs. Earthworms made up nearly a fifth of the food, while ground, carrion, and darkling beetles maintained about the same proportions as in June. The only vegetable food other than rubbish worthy of notice occurred in a single stomach, which was filled with the skin and pulp of an unidentified fruit.

Summary.—As is the case with several other resident species the robin does its most effective work in early spring. Much of its time is then spent about the borders of alfalfa fields, where many weevils are emerging from winter quarters. Though the actual percentage for April (14.29) is less than two-thirds of that for June (23.77), there is no question that the good done is much greater in the earlier

month, when the rigors of winter have reduced the insect to its lowest ebb; and any agency in the work of destruction that can be brought to bear at this time is of the utmost importance. The food of the robin in Utah speaks highly in its favor. Some complaint was heard that it injures cherries, but this trait does not seem sufficiently uniform to offset the good it does. Until the weevil is reduced in numbers the services of the robin as a destroyer of breeding adults alone ought to earn for it the utmost protection.

MOUNTAIN BLUEBIRD.

(*Sialia currucoides*.)

The mountain bluebird is an abundant breeder throughout the higher altitudes of Utah and in spring and fall is a migrant in the irrigated valleys. In the spring flocks of 5 to 15 often may be seen in the vicinity of infested fields. In their search for food, usually confined to the borders of fields and along roadsides where fences and telephone poles afford favorite perches, the bluebirds come in contact with hibernating or recently emerged adult alfalfa weevils. A considerable number of bluebirds were encountered in April in the Salt Lake Valley, and in July they were found in post-breeding flocks in alfalfa fields in the Weber Valley. At the latter place the fully fledged young were feeding extensively on the larvæ, which were then present in great numbers.

Of seven birds collected in April five had fed on breeding weevils. In bulk the weevils composed over 4 per cent of the food and were taken at an average of about two and one-half per bird. Twelve was the highest number recorded for any individual.

The major portion of other animal food at this time of year consisted of caterpillars (32.5 per cent) and ground beetles (31.3 per cent). In one stomach eight cutworms formed about four-fifths of the food and in another a similar number composed over 72 per cent. Among the ground beetles the genus *Amara* predominated. Crickets appeared prominently in two, and in one a large number of dung beetles (*Aphodius*) formed about two-thirds of the food.

Each of the nine birds collected during July had fed on the insect, which amounted to 11 per cent of the food. One, a juvenile bird, had eaten at least 70 of the larvæ, forming 40 per cent of its food; another, 17 larvæ and 5 adults; and a third about 12 larvæ and 3 adults.

The remaining animal food of the bluebirds at this time was characterized by a large proportion of hemipterous remains made up largely of the small cicada (*Platypedia putnami*), so abundant among the oak chaparral of the foothills.

The mountain bluebirds, like many other spring and fall migrants, render their most valuable services as weevil destroyers in early spring. More extensive investigations of their general food habits

have established the fact that, as a family, they are among the most persistent of insect feeders and at the same time molest no product of the farm. Their presence should be fostered at every opportunity, and there is reason to believe that as our western country becomes more thickly settled these gentle birds may become as familiar about dooryards as are their eastern relatives.

ENGLISH SPARROW.

(*Passer domesticus*.)

From its enormous abundance throughout much of the weevil-infested region of Utah, as well as from the fact that, individually, it is a most effective enemy of the alfalfa weevil, the English or house sparrow must be placed very high in the scale of weevil enemies. There is no bird in which the people of Utah are more interested than this much-criticized foreigner and, as its efficiency as an insect destroyer has frequently been questioned, special pains have been taken to present as thorough a consideration as possible of the relation of the sparrow to the alfalfa weevil.

The English sparrow presents a problem in Utah somewhat different from that in many other parts of its range. Though by no means uncommon in the city streets, the never-ceasing chatter of hundreds of these birds heard along country roads and about farmyards readily makes an observer realize that in many rural sections of the Salt Lake Valley this species is by far the most abundant.

A factor partly responsible for this condition is the presence on almost every farm of one or more straw-thatched sheds for housing live stock and in these the birds nest. (See Pl. I, fig. 2.) These sheds are constructed usually with the ceiling about 8 or 9 feet from the ground. The framework is made of heavy logs overlaid with limbs and smaller boughs, and upon this the straw is placed to a depth of 2 to 5 feet. Into the straw the sparrows dig holes about the size of one's arm and sometimes extending inward for a foot or 18 inches. Masses of nest material also may be found placed upon the beams or limbs used in the framework. Frequently upward of 100 nest holes, both occupied and deserted, may be found in a roof about 20 or 30 feet in dimensions. Lombardy poplars, cottonwoods, and box elders, abundant in the valley, are also favorite nesting sites.

FOOD OF YOUNG BIRDS.

For investigating the food habits of young English sparrows 1,039 stomachs, mostly of nestlings, are available. These were secured as follows: First half of May, 16; second half, 530; first half of June, 382; second half, 36; first half of July, 40; and second half, 35. The bulk of this material was collected from the middle of May to the middle of June, which about coincides with the period of greatest abundance of these young birds as well as of the larval form of the weevil. The largest number was from the vicinity of Murray,

Midvale, West and South Jordan, Sandy, and Riverton, an area in which this bird is by far the most abundant species.

May 1 to May 15.—Examination of birds collected during this interval showed that the parent birds were already visiting alfalfa fields for food for the hungry nestlings. The weevils fed to the young were adults which had hibernated, a very important economic service when is considered the potential harm of each pair of weevils during the course of a season, as embodied in their progeny.

About one-half of the total animal food, 14 per cent, consisted of the weevil. Thirteen of the 16 birds collected had fed on this insect, indicating that this food is probably picked up whenever found. These nestlings had eaten a total of 218 adult weevils, or an average of $13\frac{5}{8}$ per bird. A brood of three, about 2 or 3 days old, had eaten 60, 50, and 32 per cent, representing 58, 41, and 28 weevils, respectively.

The contents of these stomachs consisted of 28.06 per cent animal and 71.94 per cent vegetable matter. Of the animal food other than weevils 4.19 per cent was caterpillars, while 4.37 per cent consisted of scarabæid beetles of the genus *Aphodius*. Ground beetles aggregated 2.56 per cent; Hymenoptera, 1.12 per cent; and Orthoptera (grasshoppers and crickets), slightly less than 1 per cent. The remaining portion of animal matter was composed of other insects in small quantities.

The largest portion of the vegetable food was wheat, found in 15 of the 16 stomachs, and amounting to 65.62 per cent.

May 16 to May 31.—The weevil was eaten by the 530 birds to the extent of 36.12 per cent of the stomach contents, which is the highest proportion of this food eaten in any of the semimonthly periods covered. As this figure was obtained from the examination of so large a series of stomachs, it doubtless is not far from a true representation of what these young birds do at this time of year. The remarkable persistency with which the parent birds seek this food for their young is well shown. Of 530 young birds, only 19, or 1 out of about every 28, had failed to eat the weevil.

Among the birds notable for their stomach contents were 7 in which the weevil composed the entire food, 11 in which it amounted to 90 per cent or over, and 16 in which it was 80 per cent or over. The number of insects that may be contained in the stomachs of these young birds is remarkable. A nearly fledged young of a brood of four had eaten no less than 20 adults and 110 larvæ, while the remaining three had consumed 27 adults and 29 larvæ together. Two young birds, about a week old, had eaten 62 adults and 92 larvæ between them. A brood of four, about 4 days old, had taken, respectively, 38 adults and 33 larvæ, 33 adults and 65 larvæ, 41 adults and 67 larvæ, and 25 adults and 60 larvæ, or an average of $34\frac{1}{4}$ adults and $56\frac{1}{4}$ larvæ apiece, equaling 51 per cent of the stomach contents. An-

other brood had eaten a total of 53 adults and 200 larvæ, averaging $10\frac{2}{3}$ adults and 40 larvæ for each bird. Four other young, about 2 days' old, had devoured 4 adults and 195 larvæ.

A brood of three, 3 or 4 days old, had taken a total of 210 adults and 12 larvæ from a badly infested field adjacent to the shed in which the nest was located. Another brood of the same number had eaten 190 and 15; a brood of two, 129 and 5; while three other young birds, 3 or 4 days old, had taken no larvæ, but had consumed 183 adult weevils. On May 27 the writer collected a brood of five young birds, 5 or 6 days old, whose stomachs contained a total of 308 adults and 151 larvæ, an average of 61.6 and 30.3 per bird, and amounting to 70.4 per cent of the contents.

Of the 530 stomachs collected for this period, there was one which contained over 100 larvæ, 7 which had from 75 to 99, 29 with from 50 to 74, and 90 with from 25 to 49. As to adult weevils, there were 5 stomachs containing from 75 to 99, 21 with from 50 to 74, and 74 with from 25 to 49. Many stomachs contained from 15 to 25 larvæ, as well as adults, the total frequently exceeding 40 individuals.

The food, other than weevils, next most important was Lepidoptera, comprising 18.36 per cent of the contents, and almost entirely made up of caterpillars. In 28 stomachs caterpillars composed three-fourths or more of the contents. Though at present these insects are not causing so much damage as the weevil, yet the good service of the birds in destroying them must be recognized. Ground beetles (*Carabidæ*) made up 4.65 per cent of the stomach contents, the principal portion being of the genus *Amara*. Diptera, made up largely of Tipulidæ (crane flies), comes next in order, with a percentage of 3.9. Spiders, eaten principally during the first 2 or 3 days of the nestlings' life, composed 3.78 per cent, and scarabæid beetles, mainly of the genus *Aphodius*, represent 2.75 per cent. Hymenopterous insects made up 2.08 per cent of the contents. The remainder of the animal food, a little less than 3 per cent, was scattered among several groups of insects, of which carrion beetles (*Silphidæ*), grasshoppers, and bugs (*Hemiptera*) were most important.

The vegetable food, as usual, was composed almost entirely of wheat and oats. Much of this must be considered waste, though some complaints that sparrows steal chicken feed are verified by this examination.

June 1 to June 15.—A percentage of 26.75 shows the extent to which the 382 young, examined in this period, were feeding on the weevil. A total of 4,907 adults and 5,336 larvæ were eaten, an average of 12.85 adults and 13.97 larvæ for each bird. In 1911 of 22 birds 3 had failed to feed on the insects, while in 1912 only 1 out of 360 did not eat them, this being a very young bird in which spiders and caterpillars formed much of the stomach contents.

Stomachs containing remarkably large numbers of these insects for so small a bird are to be found in this material. One brood of five half-grown young consumed, respectively, 55 larvæ and 1 adult; 110 larvæ and 2 adults; 95 larvæ and 3 adults; 85 larvæ and 4 adults; and 123 larvæ and 1 adult, an average of 93.6 larvæ and 2.2 adults for each bird. A brood of three averaged $5\frac{2}{3}$ adults and 88 larvæ apiece, one of these having eaten 170 larvæ and 5 adults, the largest number recorded for a young of this species. Four young collected on June 1, 1912, were still busy with the breeding adults, which were abundant, 272 adults as well as 4 larvæ being consumed, an average of 68 adults and 1 larva apiece. Another hatch of 4, about two-thirds grown, had taken a total of 54 larvæ and 176 adults, one of these alone having eaten 42 larvæ and 50 adults. Another brood of 4 were making heavy inroads on the larvæ, a total of 218 larvæ and 26 adults being their record. A single bird of another hatch had destroyed 150 larvæ and 14 adults, while another made away with 95 larvæ and 8 adults. Numerous other cases occurred where individual nestlings had eaten upward of 50 weevils in one stage or another of development.

Of the 382 birds examined 5 had eaten more than 100 larvæ; 6 had taken from 75 to 99; 17, from 50 to 74; and 49, from 25 to 49. The adults were not taken in quite so large numbers, two birds having eaten from 75 to 99; 9, from 50 to 74; and 46, from 25 to 49.

The total animal food in this period was 60.81 per cent, of which 35.06 was other than weevil. About one-third of this, or 11.3 per cent, consisted of Lepidoptera, principally caterpillars; 7.15 per cent was ground beetles (*Carabidæ*); 5.31 per cent Diptera, mainly Tipulidæ; while the remainder, 11.3 per cent, was made up of various insects, of which dung beetles (*Aphodius*), bugs (Hemiptera), grasshoppers, spiders, and parasitic Hymenoptera were most important.

The vegetable food (comprising 39.19 per cent of the contents) is again characterized by the predominance of wheat, with a little other grain and some weed seeds.

June 16 to June 30.—Most of the first crop of alfalfa has been cut by this time, and in badly infested regions the fields are kept barren by the work of the larvæ, which prey on every green shoot of the new crop as it makes its appearance. English sparrows still frequent the fields after food for their young, though the increased percentages of some of the other food items, especially grasshoppers, indicate that the weevil is becoming less abundant. Many insects have pupated, and in that stage are little eaten by birds. Thirty-six stomachs collected in this half of the month show a percentage of 18.25 of weevil food. All but three of these contained the insect. Examination revealed a noticeable decrease in the number of these insects taken by young birds at this time—an average of but 4.97 adults and 5.36

larvæ apiece. A single pupa was eaten by one bird, while many of the adults were those of the new brood. Only a few stomachs are especially noteworthy. The highest number of weevils taken by any bird in this period was 52 larvæ and 9 adults, eaten by a nestling. Three other birds had taken 27 larvæ, 26 larvæ and 3 adults, and 20 larvæ, respectively.

Considerable interest is attached to the other animal food, which amounted to nearly 42 per cent of the contents. Grasshoppers and crickets occurred in more than half of the stomachs, amounting to 16.3 per cent, while injurious caterpillars totaled 19.64 per cent. Weevils, other than *Phytonomus*, and spiders comprised 1.50 and 1.88 per cent, respectively, while Hymenoptera, mainly parasitic, made up 1 per cent. The vegetable food, 39.78 per cent, showed a slight increase in the consumption of weed seeds, but by far the largest portion, 36.64 per cent, was grain, some of which was that taken from the newly headed crop.

July 1 to 15.—The 40 stomachs collected in this period show a remarkable falling off in the amount of weevils eaten, *Phytonomus* composing only 0.77 per cent of the contents. This may be largely accounted for by local conditions. Most of the birds were secured at a point where grasshoppers were appearing in large numbers and, though alfalfa fields which had been badly infested earlier in the season were near-by, but few weevils were found at this time. Most of those eaten were adults of the new brood, but they averaged less than one apiece for the birds collected, while the 40 birds together had eaten but 13 larvæ.

The abundance of grasshoppers is readily indicated in the results of the stomach analysis, which showed a percentage of 35.23, or nearly three-fourths of the animal food. These insects were present in 36 stomachs, and in several instances composed more than 90 per cent of the contents. Caterpillars were still frequently taken, amounting to 8.82 per cent. Of the vegetable food, 52.03 per cent of the contents, the greatest portion (51.63 per cent) was wheat. In this case it was almost entirely composed of grain taken from the growing crop.

July 15 to July 31.—By this time the second crop is well advanced in most fields and serious damage by the weevil has ceased for the season. Most of the weevils abroad are adults of the year's brood. The 35 stomachs collected gave a weevil percentage of 9.2. This increase over that of the first half of the month may be largely attributed to more favorable local conditions, though there probably were more adult weevils available. The birds had eaten an average of 4.82 adults and 1.63 larvæ each, and the insect occurred in 31 of the stomachs, usually in limited numbers. Were a larger amount of material available, a gradual decrease in this work as the month

progressed probably would be manifest. The largest amount eaten by any was by a nestling 3 or 4 days old, which had 13 larvæ and 14 adults in its stomach. Orthoptera (grasshoppers and crickets) continued to increase and in this series of stomachs comprised nearly a quarter (24.71 per cent) of the total contents, being eaten by 20 of the 35 birds. Ground beetles, Hemiptera, Lepidoptera, and Hymenoptera, made up the bulk of the remainder. The vegetable food, practically all grain, amounted to 58.20 per cent.

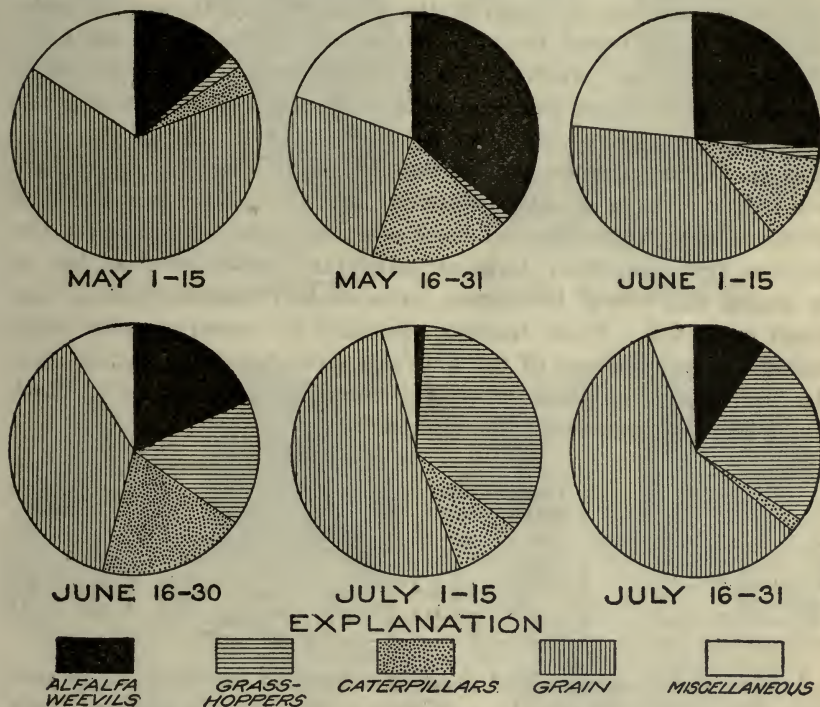


FIG. 2.—Diagram showing the food of young English sparrows during semimonthly periods in May, June, and July.

The diagram presented in figure 2 and the following tabulation represent each of the six semimonthly periods from the first of May to the end of July, and the proportions of the various food elements may easily be seen by comparing the various sectors of the different circles:

Semimonthly periods.	Alfalfa weevils.	Grass-hoppers.	Caterpillars.	Grain.	Miscellaneous.
May 1-15.....	14.00	0.94	4.19	65.62	15.25
May 16-31.....	36.12	.66	13.36	25.05	19.81
June 1-15.....	26.75	1.03	11.30	33.84	22.08
June 16-30.....	18.25	16.30	19.64	36.64	9.17
July 1-15.....	.77	35.23	8.82	51.83	3.35
July 16-31.....	9.20	24.71	1.86	58.20	6.03

Stomach analysis of these birds also revealed the fact that the value of the young English sparrow as a weevil destroyer varies considerably and rapidly as his nestling life progresses. From the blind, naked, and helpless bird of a day or two, which must necessarily be fed on the softest and most easily assimilated foods, as weevil larvæ, caterpillars, spiders, etc., to the lusty-lunged fledgling, whose food is characterized by grain and hard-shelled insects, differing but little from that of the adult, we find all intermediate stages. That some idea may be given of the proportion of the several principal food items found to occur at various stages of the nestling's life, the writer has arranged the material into four groups which represent as nearly as possible birds of the first, second, third, and fourth quarters, respectively, of the nestling life. Six of the principal food items, namely, alfalfa weevils, ground beetles, caterpillars, flies, spiders, and grain, are considered in showing the change of food habits as life progresses, and these are illustrated in figure 3. Orthoptera (grasshoppers) form an important article of food late in the season and would have been included had field work been continued until fall. These insects, especially the nymphs, were eaten extensively by nestlings of the first and second quarter during July. The following tabulation shows the changing percentages of foods during the four quarters of nestling life:

Quarterly periods.	Alfalfa weevils.	Ground beetles.	Caterpillars.	Flies.	Spiders.	Grain.	Miscellaneous.
First quarter.....	37.95	2.55	26.65	6.71	6.43	5.28	14.43
Second quarter.....	29.87	5.11	16.09	4.01	1.99	31.69	11.24
Third quarter.....	26.05	6.23	4.72	2.55	.69	49.25	10.51
Fourth quarter.....	18.75	7.43	3.12	.62	.35	63.18	6.55

As the bird becomes older there is a gradual decrease in the consumption of weevils, as well as of other soft and easily digested foods, as caterpillars, flies, and spiders, while the hard-shelled ground beetles are taken in greater quantity. Grain, mostly wheat, early becomes an important food item, and by the time the bird has left the nest it is well fitted to uphold the reputation of its parents.

FIELD OBSERVATIONS ON THE FEEDING OF NESTLINGS.

Observations also were made of the amount of food given the young English sparrows and the frequency of the feedings. Parent birds were timed for a period, usually an hour, and at the end of this time the incoming bird was captured and the contents of its bill and throat recorded. By taking the average of a number of such observations the writer was able to get a fair idea of the amount of food consumed daily by a nest of these young birds.

In the first observation a sparrow was noticed feeding four nearly fledged young. The parent bird appeared at the nest with food at an average of once every $7\frac{3}{4}$ minutes. When examined on the last trip the incoming bird had two grains of wheat in its bill.

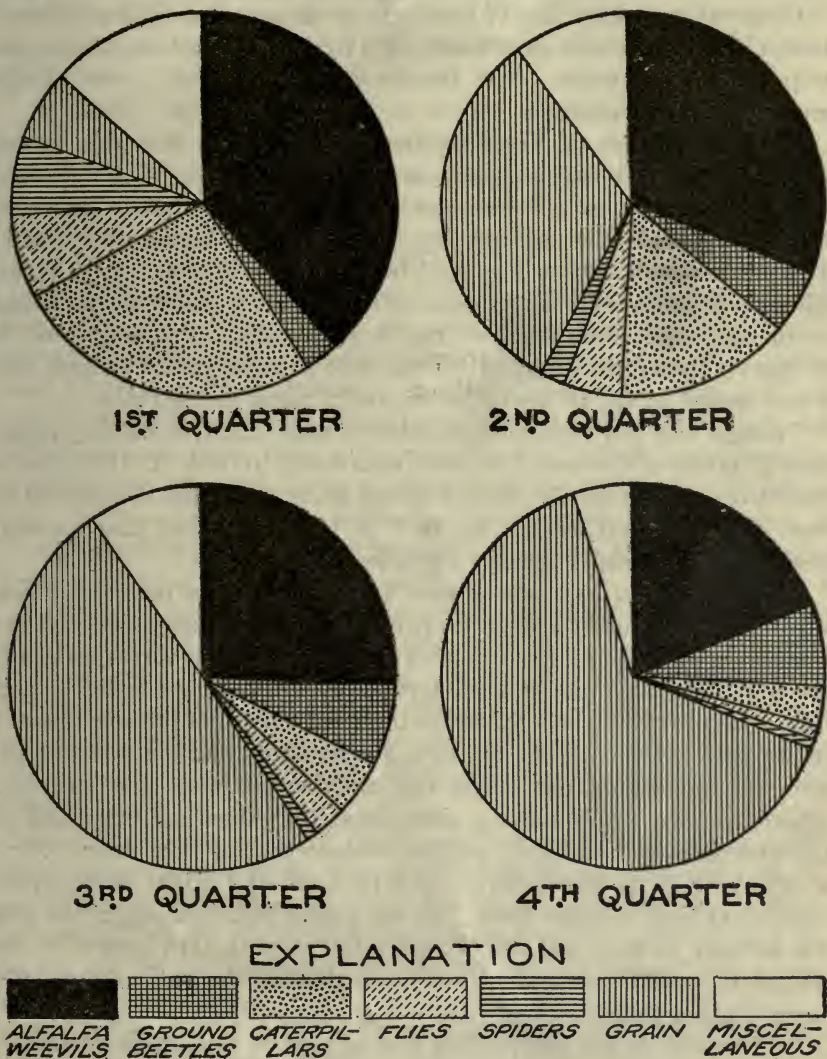


FIG. 3.—Diagram showing the food of young English sparrows during the four quarters of their nestling life.

Another observation gave an average of $5\frac{5}{11}$ minutes for every feeding. This nest contained two young, about 4 or 5 days old, but the writer failed to secure the adult at the end of the hour.

Observation of a brood of six young, 4 to 5 days old, showed that feedings took place at 5-minute intervals. The male, which was captured, carried 17 larvæ of the weevil in his bill.

Another series of observations gave an average of 5 minutes between the feedings. The female in this case carried a ground beetle (*Harpalus amputatus*), a caterpillar, and 9 larvæ of the alfalfa weevil in her bill and throat.

Observations of feeding of nestlings on an unoccupied farm showed that visits were made at the rate of 17 trips an hour, or about one trip every $3\frac{1}{2}$ minutes. The female was carrying 28 larvæ of the weevil on her last trip.

From this series of five observations it appears that the parent English sparrows visited their nest on an average of about once every $5\frac{1}{3}$ minutes, or a little more than 11 trips an hour. The four adults captured had as food for their young 2 kernels of wheat; 17 alfalfa weevil larvæ; 1 ground beetle, 9 weevil larvæ and a caterpillar; and 28 weevil larvæ, respectively. Three other adults taken in the fields had food for nestlings in their bills. This amounted to 18 weevil larvæ and an aphid in the first, 5 larvæ in the second, and 3 coccinellid larvæ, 13 weevil larvæ, and 2 pupæ in the third.

Though this is a rather heterogeneous assortment, it would appear that 15 larvæ of the weevil or their equivalent in bulk of other insects would be a fair estimate of an average amount of food brought in at each trip by adult birds. In fact, it is certain that the material brought in frequently greatly exceeded this amount.

Allowing, then, 15 larvæ at each trip and 11 trips per hour, these birds would bring in 165 larvæ per hour. Then, assuming that the young were being fed for 12 hours each day, a conservative estimate, we would have a total of 1,980 larvæ consumed by one brood in one day. As previously stated, straw-thatched sheds containing upward of 100 nest holes, both old and new, are frequent, and it is not uncommon to find farmyards where this number of nests are occupied. There are also ample nesting sites about the other buildings and in the ever-present Lombardy poplar, cottonwood, or box elder. Such a colony of birds would devour a daily total of 198,000 larvæ, or an equivalent bulk in other food. As the young birds remain in the nest for at least 10 days and are probably fed several days longer by the adults, they will have eaten food equivalent to the bulk of 1,980,000 larvæ during their nestling life.

As these birds are not feeding exclusively on this insect, the average amount of weevils eaten by young English sparrows during the height of the season being about 25 per cent of their food, under average conditions we would have the young of such a colony eating 495,000 weevils. While there may be some farms where only comparatively few larvæ are eaten, there must be others where favorable circumstances will bring the total destroyed by the nestlings of one brood nearer the larger figure.

To the number of weevils destroyed by the young we must add those eaten by the adult birds during this time. As four nestlings appear to be a fair average for a brood, there would be one-half as many adults as young; and although the food of old birds was only about 18 per cent weevils during May, June, and July, it amounts to a considerable quantity in the period that they have young in the nest to feed.

While the writer does not wish to have too great emphasis placed upon such somewhat theoretical deductions, at least they serve to show, with a fair degree of certainty, what might be expected of such a colony under favorable circumstances.

ADULT ENGLISH SPARROWS.

Careful observation shows that adult sparrows are frequent visitors to alfalfa fields. Their visits are most often when there are young to be fed, and at such times the parent birds consume much the same kind of food as their progeny, especially the adult weevil. Fields nearest barnyards, where these birds nest, are benefited most, but numerous cases were observed where the adult birds were traveling considerably over 100 yards to secure the desired food. Wherever these birds nested in large numbers a more or less regular stream of adult sparrows was observed flying to and from the badly infested portion of some near-by alfalfa field.

In the two seasons' work 104 stomachs of adult English sparrows were collected, 14 in April, 67 in May, 20 in July, and 3 in August.

April.—But few adult English sparrows were found in alfalfa fields this early in the season. Breeding and nest building were occupying their time, and they were seldom seen far from farm buildings, where they found ample food in horse droppings and chicken feed.

Weevils (adults in every case) occurred in 6 of the 14 stomachs and amounted to a little over 1 per cent of the contents. As the entire animal food amounted to but 2.57 per cent, the weevil formed almost half of it. In every case save one, only a single insect was taken, and in that instance two adult weevils composed 10 per cent of the contents.

The other animal food consisted entirely of dung beetles (*Aphodius*). Seeds of such plants as pigweed (*Chenopodium*), amaranth (*Amaranthus retroflexus*), and filaree (*Erodium cicutarium*) made up 3 per cent, while the remainder was grain, mostly wheat.

As these birds were collected in April, 1912, when very inclement weather prevailed, the food was confined almost entirely to that secured about the barnyard.

May.—The 63 birds taken in May indicate a beginning of the season's work on the alfalfa weevil. Forty-six had feed on the insect,

which amounted to 8.75 per cent of the stomach contents, and an average of 2 adult weevils and 2.1 larvæ for each bird was recorded from this series. One bird had eaten 5 adults and 43 larvæ, and another 2 adults and 26 larvæ. A bird collected in 1912 had eaten 25 breeding adults.

The remainder of the animal food (1.05 per cent) was divided in small quantities among insects of several orders. The vegetable portion, as usual, was conspicuous by the high percentage of grain (87.19) while the remainder (3 per cent) was weed seeds.

June.—The highest percentages of weevils eaten by the parent birds were in June. The 20 birds examined had destroyed 26 adults and 229 larvæ, an average of 1.3 adults and 11.45 larvæ apiece, amounting to 29.55 per cent of the contents. Only 4 of the 20 had failed to eat at least one weevil. One had eaten 49 larvæ and 1 adult, comprising 90 per cent of the contents; another had taken 41 larvæ, while the 27 larvæ and 2 adults eaten by a third amounted to 99 per cent of its food. Most of these birds had nestings to feed, and the contents of their bills is recorded under the consideration of the food of nestlings.

The greater portion of the remaining animal food was composed of weevils other than *Phytonomus*. Of the vegetable portion, 68.4 per cent, a little over 3 per cent was weed seeds, while the remainder was grain, mostly wheat.

July.—In July only three adult sparrows were examined—far too small a number from which to make reliable deductions. However, these showed that weevils were still being eaten, as they were present in all three stomachs, averaging 18 per cent of the bulk, which, save a single clover-root weevil (*Sitones*), was the entire animal food. This latter insect, known to do damage to alfalfa as well as clover, was found quite frequently but in small quantities in the stomachs of both adult and young sparrows.

SUMMARY.

Considering the various phases of the economic relation of the English sparrow to the alfalfa weevil, it may safely be asserted that this bird is a most effective enemy of the pest. This is particularly true of nestling birds in May and June. In view, however, of the ability of this bird to do serious damage to standing grain, and to take heavy toll from the farmers' chicken feed, legal protection for the species can not be advocated. While there doubtless are altogether too many of these birds about some farms, a reduction in their numbers may be much more satisfactorily effected by the individual farmer¹ than by the aid of a bounty law, such as has been in force

¹ Full directions for trapping and poisoning English sparrows, as well as directions for their use as food, may be found in Farmers' Bulletin 493, U. S. Dept. of Agr., The English Sparrow as a Pest, by Ned Dearborn.

in some counties of Utah for the past few years. Such a law, besides being an incentive to misrepresentation and fraud and expensive in its operation, very frequently, as in this case, utterly fails in accomplishing its object.

BIRDS NOT FEEDING ON THE WEEVIL.

A number of Utah birds which had not fed on the alfalfa weevil were also examined. From the nature of their food habits or from the isolation from alfalfa fields of their favorite habitats some are prevented from becoming potent factors in the control of the weevil, but additional field work might show others to be enemies of the pest. The following species were examined, the number of each being indicated:

Black-crowned night heron (<i>Nycticorax nycticorax naevius</i>)	1
Avocet (<i>Recurvirostra americana</i>)	2
Black-necked stilt (<i>Himantopus mexicanus</i>)	1
Western willet (<i>Catoptrophorus semipalmatus inornatus</i>)	1
Long-billed curlew (<i>Numenius americanus</i>)	1
Snowy plover (<i>Ægialitis nivosa</i>)	2
Desert sparrow hawk (<i>Falco sparverius phalæna</i>)	2
Burrowing owl (<i>Speotyto cunicularia hypogæa</i>)	2
Lewis's woodpecker (<i>Asyndesmus levisi</i>)	2
Black-chinned hummingbird (<i>Archilochus alexandri</i>)	1
Kingbird (<i>Tyrannus tyrannus</i>)	6
Olive-sided flycatcher (<i>Nuttallornis borealis</i>)	1
Pale goldfinch (<i>Astragalinus tristis pallidus</i>)	4
Northern violet-green swallow (<i>Tachycineta thalassina lepida</i>)	1
Cedar waxwing (<i>Bombycilla cedrorum</i>)	2
White-rumped shrike (<i>Lanius ludovicianus excubitorides</i>)	1
Rock wren (<i>Salpinctes obsoletus obsoletus</i>)	1
Ruby-crowned kinglet (<i>Regulus calendula calendula</i>)	2

DOMESTIC FOWLS AS WEEVIL ENEMIES.

The efficient work of domestic fowls in feeding on the alfalfa weevil had been noted by many farmers, and a few were making excellent use of broods of young chickens and turkeys by placing them in badly infested fields. Here these fowls satisfied their appetite for animal food, and when their feeding was confined to a limited area there was a noticeable improvement in the subsequent growth of alfalfa.

Mr. William Blood, of Kaysville, conducted experiments with chickens in the summers of 1911 and 1912. After cutting the first crop in a field of about 15 acres he set out three colony houses containing 100 eight-weeks-old chicks, 90 five weeks old, and 160 two weeks old, respectively. These broods were moved from place to place as the area about the houses was cleaned up. In this way the work of these diligent workers was distributed over most of the field.

On June 29 the writer made the photographs reproduced in Plate V. Figure 1 shows the growth at a point in the field where the chickens were allowed to do their first work after the cutting of the crop. The second crop responded immediately, and some of the stalks were 9 to 10 inches high. The stake shown in the foreground is about 3 inches high. Figure 2, taken on the same day, shows the bare and apparently dead stubble of the first crop at a place farthest from the colony houses where the chickens had not been feeding.

There may be danger when a limited area is overstocked with chickens that their feeding on the growing crop will impair its progress, but by a judicious scattering and moving of the broods these young birds may be used to excellent advantage. They not only materially benefit the subsequent crop of alfalfa, but also find an abundant supply of animal food.

OTHER VERTEBRATE ENEMIES OF THE WEEVIL.

As toads (*Bufo lentiginosus woodhousei*) were abundant in well-watered fields, and frogs (*Rana pipiens*) were often found in alfalfa adjacent to ditches, an investigation was made of their food habits, and it was found that both were feeding on the weevil. A salamander (*Ambystoma tigrinum*) collected in 1911 had eaten one adult. A blue racer (*Zamenis constrictor flaviventris*) collected north of Salt Lake City, and another taken near Bountiful, had failed to eat any. Mr. E. G. Titus records¹ horned "toads" (*Phrynosoma* spp.), swifts (*Lacertilia*), and a small garter snake (*Eutania* sp.) as enemies. He also mentions having found a shrew (*Sorex* sp.) which had fed on a single weevil. The stomach of one of these, a *Sorex obscurus*, collected by the writer near Midvale contained none.

As a fairly good series of stomachs of both the Rocky Mountain toad and the leopard frog were secured, a detailed account of their relation to the weevil follows.

ROCKY MOUNTAIN TOAD.

(*Bufo lentiginosus woodhousei*.)

Toads are essentially nocturnal, especially during the hot, dry months of summer at the altitude of the Salt Lake Valley. Although on cool, cloudy days they may be abroad in alfalfa fields, ordinarily they seldom feed much before sundown or after the morning sun has dried the dew.

As an enemy of the alfalfa weevil the Rocky Mountain toad renders its best service in the destruction of breeding adults during spring and early summer. Later in the year the bulk of the larvæ

¹ Bull. 110, Utah Agr. Coll. Exp. Sta., p. 49, Sept., 1910.



FIG. 1.—WORK OF CHICKENS ON AN INFESTED FIELD.

[This shows the second crop of alfalfa well started in a part where chickens had been allowed to feed. The stake in the left foreground is about 3 inches high.]



FIG. 2.—PART OF SAME FIELD WHERE CHICKENS HAD NOT FED.

[Note the dry leafless stubble of the first crop two weeks after cutting. Photographs taken the same day.]

are out of its reach, except when the crop has been cut. At such times larvæ which have been dislodged and are seeking new feeding places are quickly seized by the hungry toad. After raking, the same condition prevails until the larvæ have again established themselves and become practically stationary during their feeding operations. Mr. E. G. Titus records having examined the stomach of a toad found in a recently cut field.¹ Over 800 larvæ had been eaten by this batrachian, "and there was also present a mass of more or less digested animal matter which apparently contained a good many more larvæ. From this same toad there were also taken 75 (adult) weevils, and there were in the partly digested mass the wing covers of more weevils." Though the writer collected toads which had eaten a considerable number of larvæ, none had equaled this remarkable record.

Twenty-eight specimens of this toad were collected, 2 in April, 8 in May, and 18 in June.

Each of the two taken in April had fed on the adult weevil, one having eaten 9 and the other 20, which amounted to over a fifth of their food. Besides this they had fed on several ground beetles of the genera *Harpalus*, *Amara*, and *Pterostichus*. These formed over half of the stomach contents. In one stomach was also a large crane fly, and in the other a mass of ants.

Seven of the eight toads collected in May had eaten the weevil, adults in all cases but one. In bulk this element formed nearly 15 per cent of the food and was taken on an average of about 10 for each toad. Thirty-eight adults was the highest number recorded for an individual. Besides the weevil a large quantity (30 per cent) of ground beetles, mostly of the genera previously mentioned, was consumed. Ants occurred in seven stomachs, forming nearly 18 per cent of the food. Click beetles (*Drasterius elegans* and *Monocrepidius vespertinus*), which were abundant in some sections, and do serious injury to such crops as corn and wheat, were eaten freely. Even the large sluggish cutworm so common in alfalfa fields was also taken.

Sixteen of the 18 toads secured in June had fed on the weevil to the extent of about a twelfth of their food, and at an average of about 15 adults and 1½ larvæ apiece. One had devoured 83 of the adults and another had made away with 28 adults and 15 larvæ. Ground beetles were eaten by every one of the toads and formed nearly a fourth of the food. One toad had taken no less than 68 *Amara fallax*, which at times are injurious to vegetation. Ants were present in all but two of the stomachs and in bulk amounted to over 21 per cent. Among these were found many specimens of the western harvest ant (*Pogonomyrmex occidentalis*). Numerous other

¹ Bull. 110, Utah Agr. Coll. Exp. Sta., p. 50, Sept., 1910.

Coleoptera, including May beetles, click beetles, darkling beetles, and a few weevils, made up nearly an eighth of the food. Caterpillars (7.9 per cent), spiders (2.1 per cent), and miscellaneous insects (7.8 per cent) composed the bulk of the remaining contents. About half of these stomachs contained varying quantities of vegetable rubbish, doubtless swallowed accidentally along with the insects.

While the toad destroys a considerable number of beneficial ground beetles, some "ladybirds" (Coccinellidæ), carrion and dung beetles (Silphidæ, *Aphodius*, etc.), and spiders, it also destroys even greater quantities of insects highly injurious to man. Among these may be mentioned May beetles (the adults of the white grub); click beetles (parents of the wireworm); various snout beetles, including the alfalfa weevil; ants; and caterpillars, including cutworms and army worms. The function of the toad in nature appears to be a rather indiscriminate reduction of insect life coming within reach. These batrachians therefore are especially valuable in the suppression of a terrestrial insect which has become unduly abundant. As such a condition prevails in Utah, every effort should be made to conserve the numbers of this valuable insect destroyer, whose worth is generally underestimated.

LEOPARD FROG.

(*Rana pipiens*.)

This alert batrachian often may be found in alfalfa adjacent to water and in low, damp fields. Like the toad, it is highly insectivorous, but in its more aquatic environment its diet differs somewhat. Conditions are not so favorable for its becoming as effective an enemy of the alfalfa weevil as the toad, although adult weevils hibernating in the brush along ditches may form an appreciable portion of its food.

Two of the three frogs secured in May had fed on the weevil, in each case a single insect being taken. In bulk this averaged about 1 per cent of the food. Ground beetles, earthworms, flies, spiders, and neuropterous insects were the principal other components.

In June four of the six collected had eaten weevils, which formed a larger proportion of the diet ($2\frac{1}{2}$ per cent). One frog had eaten six adults, and larvæ had been taken in three of the four cases. Ground beetles, which again figured prominently in the diet, occurred in five of the six stomachs and formed about 40 per cent of the food. A stink bug (*Euschistus variolarius*), which has been injurious to vegetation, appeared to be a favorite food. It formed 17 per cent of the stomach contents. Click beetles, caterpillars, and spiders made up the greater portion of the remainder. Vegetable rubbish, as in the case of the toad, was freely taken while swallowing insect food.

The food habits of the leopard frog stamp it as one of the most beneficial of the lower vertebrates. Its only harm lies in the destruction of beneficial predaceous and parasitic insects, but this is outweighed by its persistent attack upon such insect pests as mosquitoes, crickets, grasshoppers, and the predaceous water beetles injurious to small fish fry. It is deplorable that so many of these batrachians are being slaughtered, either for fish bait or for the small morsel of food which their legs afford.

CONCLUSION.

The investigation of the food habits of the birds of Utah in relation to the alfalfa weevil verifies the statement frequently made that the abundance of an insect, and consequently the ease with which it may be secured, are important factors governing the food habits of birds. With the exception of a few restrictions placed upon certain species by their methods of feeding, insectivorous birds are to a certain degree indiscriminate in their choice of food. Flycatchers, swallows, nighthawks, etc., are limited in a large measure to flying insects; thrushes, meadowlarks, blackbirds, and gallinaceous species secure most of their insect food from the ground; while warblers, chickadees, woodpeckers, cuckoos, etc., feed largely among the tree tops. It is the ground-feeding birds which come into most intimate contact with the alfalfa weevil, but birds that feed on the wing may secure the insect at the time of its spring and summer flights; and such species as search for their food over trunks of trees may come into contact with a few hibernating adults. Over much of the territory covered by the writer in his two seasons' work these bird enemies of the weevil had learned to search for the insect as a food in the comparatively short period of four or five years, a fact which makes the large proportion of this food eaten by some species the more remarkable.

With the possible exception of a fungous disease, which in some localities destroyed large numbers of the pupæ, there probably was, at the close of 1912, no other natural agency which had done more in holding the alfalfa weevil in check than the native birds. Being alert to detect any unusual abundance of suitable food in the insect world, they were among the first to turn their attention to this new pest, and when once a convenient supply of this food was found in the alfalfa these fields became popular with many species. It is quite possible that in the case of some of the birds examined a knowledge of the location of this insect had been only recently acquired, and a few years more experience with it would place these species much higher in the scale of weevil enemies.

The laws enacted in the State of Utah for the protection of bird life are, on the whole, adequate and well enforced, and the love for bird life by the people of Utah has been a powerful agency in making this possible. Since the writer's investigations in 1911-12 a law was passed (effective March 11, 1913) giving protection to one of the effective enemies of the alfalfa weevil—Brewer's blackbird. However, during the present crisis of the insect outbreak, it appears wise to suggest that added protection be given to another enemy of the weevil, and that there be removed from the statute books a bounty law on a third.

The species deserving added protection, for a short period at least, that its good work in the suppression of the weevil may continue unimpaired, is the valley quail. Its numbers at present throughout most of the alfalfa area are too limited to threaten serious harm to grain crops. In fact, from what was learned regarding the food habits of this bird in relation to the weevil, it is far too scarce for the best interests of the Utah farmer. A shorter open season or even absolute protection for a few years would rapidly increase its numbers to a point where it could do effective work on the insect.

Removal of the bounty law on the English sparrow is recommended, not so much because the bird requires added protection, as for the reason that this law, as is the case with most laws of this nature, utterly fails to materially reduce the number of these birds, and at the same time it has been the reason for the destruction of many birds of other and beneficial species. A reduction in the numbers of the sparrow, if desired, can be much more effectively accomplished either by the efforts of individual farmers or by the employment of competent men to make a thorough and extensive campaign of trapping, poisoning, or nest destruction. Where chicken feed can be protected and where grain fields will not be jeopardized these birds may well be allowed to continue unmolested their good work on the alfalfa weevil.

INDEX.

- Agelaius phoeniceus fortis*, 18-20.
 Alfalfa weevil. *See* Weevil, alfalfa.
Ambystoma tigrinum, 58.
Apelocoma woodhousei, 14-15.
 Arkansas kingbird, 9.
 Bank swallow, 40.
 Birds feeding on weevil, distribution of, 3-4.
 list of, 4-5.
 not feeding on weevil, list of, 57.
 Blackbird, Brewer's, 23-27, 62.
 red-winged, 18-20.
 yellow-headed, 17-18.
 Black-headed grosbeak, 37-38.
 Bluebird, mountain, 45-46.
 Bobolink, 15.
 Bounty laws, 36, 56-57, 62.
 Brewer's blackbird, 23-27, 62.
 sparrow, 34-35.
Bufo lentiginosus woodhousei, 58-60.
 Bullock's oriole, 22-23.
 Bunting, lazuli, 38-39.
 California gull, 5-6.
Carpodacus mexicanus frontalis, 27-28.
 Chat, long-tailed, 41-42.
 Chickadee, long-tailed, 42-43.
 Chipping sparrow, western, 33.
Chondestes grammacus strigatus, 31-33.
 Cliff swallow, 39-40.
Colaptes cafer colearis, 9.
 Conclusion, 61-62.
 Cowbird, 15-16.
Cyanocitta stelleri diademata, 14.
 Dendroica æstiva æstiva, 41.
 Desert horned lark, 10-11.
 song sparrow, 35-36.
 Distribution of weevil-eating birds, 3-4.
Dolichonyx oryzivorus, 15.
 Domestic fowls as weevil enemies, 57-58.
 Dove, western mourning, 8-9.
Empidonax traillii traillii, 10.
 Enemies of alfalfa weevil, birds as, list of, 4-5.
 domestic fowls as, 57-58.
 other vertebrate, 58.
 English sparrow, 46-57, 62.
Euphagus cyanocephalus, 23-27.
Eutænia sp., 58.
 Finch, house, 27-28.
 Flicker, red-shafted, 9.
 Flycatcher, Traill's, 10.
 Fowls, domestic, as weevil enemies, 57-58.
 Frog, leopard, 60-61.
 Garter snake, 58.
 Green-tailed towhee, 37.
 Grosbeak, black-headed, 37-38.
 Gull, California, 5-6.
 Horned lark, desert, 10-11.
 "toad," 58.
 House finch, 27-28.
Icteria virens longicauda, 41-42.
Icterus bullocki, 22-23.
 Importation and spread of alfalfa weevil, 1-2.
 Introduction, 1.
 Jay, long-crested, 14.
 Woodhouse's, 14-15.
 Killdeer, 6-7.
 Kingbird, Arkansas, 9.
 Lacertilla, 58.
 Lark, desert horned, 10-11.
 sparrow, western, 31-33.
Larus californicus, 5-6.
 Lazuli bunting, 38-39.
 Leopard frog, 60-61.
 Life history of alfalfa weevil, 2-3.
 Lincoln's sparrow, 36.
 Long-crested jay, 14.
 Long-tailed chat, 41-42.
 chickadee, 42-43.
Lophortyx californica vallicola, 8.
 Macgillivray's warbler, 41.
 Magpie, 11-14.
 Meadowlark, western, 20-22.
Melospiza lincolni lincolni, 36.
 melodia fallax, 35-36.
Molothrus ater ater, 15-16.
 Mountain bluebird, 45-46.
 Mourning dove, western, 8-9.
Oporornis tolmiei, 41.
Oreoscoptes montanus, 42.
Oreospiza chlorura, 37.
 Oriole, Bullock's, 22-23.
Otocoris alpestris leucolæma, 10-11.
Oxyechus vociferus, 6-7.
Passer domesticus, 46-57.
Passerculus sandwichensis alaudinus, 30-31.

- Passerina amœna*, 38-39.
Penthestes atricapillus septentrionalis, 42-43.
Petrochelidon lunifrons lunifrons, 39-40.
 Phalarope, Wilson's, 6.
 Phœbe, Say's, 10.
Phrynosoma spp., 58.
Pica pica hudsonia, 11-14.
 Pine siskin, 28.
Pipilo maculatus montanus, 36-37.
Planesticus migratorius propinquus, 43-45.
Poœcetes gramineus confinis, 28-30.
 Quail, valley, 8, 62.
Rana pipiens, 60-61.
 Red-shafted flicker, 9.
 Redwing, thick-billed, 18-20.
Riparia riparia, 40.
 Robin, western, 43-45.
 Rocky mountain toad, 58-60.
 Rough-winged swallow, 40-41.
 Sage thrasher, 42.
 Salamander, 58.
 Savannah sparrow, western, 30-31.
Sayornis sayus, 10.
 Say's phœbe, 10.
 Shrew, 58.
Sialia currucoides, 45-46.
 Siskin, pine, 28.
 Snake, garter, 58.
 Song sparrow, desert, 35-36.
Sorex sp., 58.
 Sparrow, Brewer's 34-35.
 desert song, 35-36.
 English, 46-57, 62.
 Lincoln's, 36.
 western chipping, 33.
 lark, 31-33.
 savannah, 30-31.
 vesper, 28-30.
 white-crowned, 33.
Spinus pinus, 28.
Spizella breweri, 34-35.
 passerina arizonæ, 33.
 Spurred towhee, 36-37.
Steganopus tricolor, 6.
Stelgidopteryx serripennis, 40-41.
Sturnella neglecta, 20-22.
 Swallow, bank, 40.
 cliff, 39-40.
 rough-winged, 40-41.
 Swift (*Lacertilla*), 58.
 Thick-billed redwing, 18-20.
 Thrasher, sage, 42.
 "Toad," horned, 58.
 Rocky Mountain, 58-60.
 Towhee, green-tailed, 37.
 spurred, 36-37.
 Traill's flycatcher, 10.
Tyrannus verticalis, 9.
 Valley quail, 8, 62.
 Vertebrate enemies, other, of alfalfa weevil, 58.
 Vesper sparrow, western, 28-30.
 Warbler, Macgillivray's, 41.
 yellow, 41.
 Weevil, alfalfa, birds feeding on, distribution of, 3-4.
 list of, 4-5.
 birds not feeding on, list of, 57.
 domestic fowls as enemies of, 57-58.
 importation and spread of, 1-2.
 life history of, 2-3.
 vertebrate enemies of, other, 58.
 Western chipping sparrow, 33.
 lark sparrow, 31-33.
 meadowlark, 20-22.
 mourning dove, 8-9.
 robin, 43-45.
 savannah sparrow, 30-31.
 vesper sparrow, 28-30.
 White-crowned sparrow, 33.
 Wilson's phalarope, 6.
 Woodhouse's jay, 14-15.
Xanthocephalus xanthocephalus, 17-18.
 Yellow-headed blackbird, 17-18.
 Yellow warbler, 41.
Zamelodia melanocephala, 37-38.
Zenaidura macroura marginella, 8-9.
Zonotrichia leucophrys leucophrys, 33.

Y. B. Separate 564.

- E -

BIRD ENEMIES OF THE CODLING MOTH.

BY

W. L. McATEE,

Assistant Biologist, Bureau of Biological Survey.

[FROM YEARBOOK OF DEPARTMENT OF AGRICULTURE FOR 1911.]

CONTENTS.

	Page.
Relation of birds and insects	237
Losses due to the codling moth.....	237
Life history of the codling moth.....	237
Destruction of larvæ by birds	238
Efficiency of bird enemies	243
Foreign bird enemies of the codling moth.....	244
Summary	245

ILLUSTRATIONS.

	Page.
PLATE X. Larva and pupæ of codling moth.....	240
XI. Holes and cracks in trees enlarged by woodpeckers searching for codling-moth larvæ and pupæ.....	240

BIRD ENEMIES OF THE CODLING MOTH.

By W. L. MCATEE,
Assistant Biologist, Bureau of Biological Survey.

RELATION OF BIRDS AND INSECTS.

Most birds are to some extent insectivorous, and many species live almost exclusively upon insects. There is no doubt that their combined attack has an important influence on the numbers of the insect army. In spite of birds and other enemies, however, it not rarely happens that certain insects suddenly increase in numbers and threaten great damage locally to crops. Instances of the suppression by birds of such strictly local outbreaks of insects are numerous. Rarely, however, do they exercise a noticeable degree of control over an insect so widely distributed and so important economically as the codling moth. Nevertheless, since 1746 nearly all entomologists who have published accounts of the codling moth have paid high tribute to its avian enemies, and they are almost unanimous in declaring birds to be the most efficient natural enemies of the pest.

LOSSES DUE TO THE CODLING MOTH.

The experts of the Bureau of Entomology state that the codling moth causes greater loss to apples and pears than all the other insect enemies of these fruits combined. They estimate the damage the insect does to the apple crop of the United States at approximately \$12,000,000 annually.¹ If account be taken of expenses incurred in attempts to control the insect, as for labor, arsenicals, and spraying apparatus, an additional sum of probably not less than \$3,000,000 or \$4,000,000, or a total of at least \$15,000,000, must be charged to the presence of this insect in the apple orchards of the United States.

LIFE HISTORY OF THE CODLING MOTH.

The life history of so important a pest has, of course, been carefully studied. It has been found by entomologists that as a rule the eggs are laid upon the leaves or the fruit. There are usually two broods of the insects and consequently two periods of oviposition, namely, in early spring and in midsummer. The eggs hatch in

¹ Yearbook, U. S. Dept. Agric., p. 435, 1907.

from 9 to 18 days, and the minute larvæ immediately hunt for the fruit. Those finding it bore in at once and spend from 10 to 30 days feeding upon the seeds and flesh around the core. At maturity the larvæ emerge, chiefly at night, and seek sheltered places, such as holes or cracks in the trees or ground, crevices under bark scales on the trunk, or refuges under boards or other litter on the ground in which to spin their cocoons. (Pl. X, figs. 2 and 3.) Here they either pupate at once in preparation for the second brood of the season, or, if winter is near, pupation is postponed till the following spring. The adults fly mostly by night.

DESTRUCTION OF LARVÆ BY BIRDS.

Thus the nocturnal habits of the species in its active stages and the fact that it is hidden at other times leave few opportunities for birds to attack it. In spite of this, however, birds destroy great numbers. Some larvæ are no doubt captured during the interval between emergence from the fruit and spinning the cocoon, but as this period is brief and usually occurs at night, a great majority of them probably reach a hiding place in safety. But woodpeckers drill through the bark flakes under which larvæ or pupæ lie in their cocoons, or enlarge cracks that shelter large numbers of these insects in immature stages, and the titmice, chickadees, nuthatches, and creepers find them in shallow crevices or by prying off loose scales of bark. Probably most of the other birds, also, which feed upon the larvæ and pupæ get them chiefly by these latter methods.

WOODPECKERS.

The most effective enemies of codling moths are those that can best attack them in their pupal chambers. It is not surprising, therefore, that woodpeckers, accustomed as they are to obtaining their food from crevices and under bark flakes, should take high rank among the foes of this pest. (Pl. XI.)

Roesel, the first man who published an accurate account of the codling moth, noted the beneficial work of woodpeckers. He says of the larvæ seeking places to pupate: "They conceal themselves so thoroughly as scarcely to be found by men; but the woodpeckers and similar birds know how to discover quickly their retreats."¹

Trimble, an American investigator, was the first to ascertain how the downy woodpecker "finds where to peck through the scales of bark, so as to be sure to hit the apple worm that is so snugly concealed beneath." After stating that the sense of smell will not account for it, he says:

¹ Roesel von Rosenhof, A. J. *Insecten-Belustigen*: 1^{ter} Theil, Der Nachtvögel, 4^{te} Classe, No. 13, p. 36, 1746.

This little bird finds the concealed larvæ under the bark, not from any noise the insect makes; it is not a grub of a beetle having a boring habit and liable to make a sound that might betray its retreat, in seasons of the year when not torpid. A caterpillar makes scarcely an appreciable noise, even when spinning its cocoon, and when that is finished it rests as quietly within as an Egyptian mummy in its sarcophagus. There is no evidence that the downy woodpecker ever makes a mistake; it has some way of judging. The squirrel does not waste time in cracking an empty nut. There is no reason to believe that this bird ever makes holes through these scales merely for pastime or for any other purpose except for food. He knows before he begins that if he works through, just in that spot, he will find a dainty morsel at the bottom of it, as delicious to him as the meat of the nut is to the squirrel. But how does he know? By sounding—tap, tap, tap, just as the physician learns the condition of the lungs of his patient by what he calls percussio. . . . Watch him. See how ever and anon he will stop in his quick motions up and down, and give a few taps upon the suspected scale, and then test another and another, until the right sound is communicated to that wonderful ear.¹

Dr. Trimble examined the stomachs of three downy woodpeckers and found codling-moth larvæ in two of them. This was in the sixties; the observation has been confirmed many times since, and the downy has been praised on all sides. Well does he deserve appreciation. In most apple orchards in the United States in fall and winter the sound of the tapping of the downy woodpecker may be heard almost every day, and many a codling-moth larva or pupa do the birds devour. The insects have been found in stomachs of this species from New York, New Jersey, Texas, and California, and no fewer than 20 larvæ have been taken from a single stomach. The downy woodpecker not only gets codling worms from the trunks of apple trees, but takes them from the fruit itself.

F. M. Webster notes that Mrs. S. H. Hine, of Sedan, Ind., a most careful observer of birds, stated that she had seen this species feeding on these larvæ, extracting them from apples which were hanging to the tree. She had watched a downy woodpecker on a tree in her yard until it worked upon an apple within her reach, and, keeping her eye on this apple, she had approached the tree and picked it. She found that the young larva had made some progress into the fruit, starting from the calyx, but that it had been deftly extracted by the woodpecker and without injury to the fruit. Mr. Webster says further:

In a conversation with Judge McBride, of Elkhart, Ind., also a careful observer of birds, he stated that he had also observed downy woodpeckers extracting the worms from young apples, and he had never observed that in so doing the birds in any way injured the fruit. It seems, then, that the labors of this bird act not only as a preventive, but also afford actual and immediate relief to the infested fruit.²

¹ Trimble, Isaac P. *Treatise on the Insect Enemies of Fruit and Fruit Trees*, pp. 116–117, 1865.

² *Insect Life*, III, p. 348, Apr., 1891.

Two western species of woodpeckers also are known to extract larvæ in the same way. Mr. W. Otto Emerson, of Haywards, Cal., in a letter to the Biological Survey, dated March 14, 1909, says:

Several cases have come under my observation when in the fall months * * * the California and Lewis woodpeckers made their appearance in canyon apple orchards and went through them, picking open the apples for the codling-moth worms they contained.

Other woodpeckers known to feed on the codling-moth larvæ are the hairy woodpecker (*Dryobates villosus*), Texan woodpecker (*Dryobates scalaris bairdi*), red-headed woodpecker (*Melanerpes erythrocephalus*), red-shafted flicker (*Colaptes cafer collaris*), and pileated woodpecker (*Phlæotomus pileatus*). Plate XI illustrates work of woodpeckers, probably mostly that of the pileated, in search of codling-moth larvæ. The red-shafted flicker is given great credit by Mr. A. P. Martin, of Petaluma, Cal., who—

writing to the Pacific Rural Press of June 27, 1890, states that in looking over his orchard last spring and examining all crevices and bark of the trees for the codling-moth larvæ, he failed to find any, where there were thousands last fall. He discovered plenty of cocoons, but in every case the former occupant was absent. It was too early for transformation to have taken place, and he found small holes in the bark scales which had been made by some bird. His belief is that the good work was done by a bird whose scientific name he does not know, but which is variously called the "yellow hammer," "flicker," or "high hole," and which Dr. Merriam informs us is, in California, *Colaptes cafer*. During the early spring months Mr. Martin states that they were to be seen by hundreds in his orchard, industriously examining the trunks and larger limbs of the fruit trees, and he also found great numbers of them around sheds where he stored his winter apples and pears. As the result of several hours' search Mr. Martin found only one worm, and this one escaped only by an accident, for several had been within a quarter of an inch of it.¹

So eager are woodpeckers in search of codling worms that they have often been known to riddle the shingle traps and paper bands which are placed to attract the larvæ about to spin cocoons. In fact, the beneficial work of woodpeckers in relation to this pest has everywhere been so conspicuous as to call forth laudations of the birds and recommendations for protecting them and attracting more of them to the orchards.

FLYCATCHERS.

One would not expect birds so expert in catching insects on the wing to resort much to tree trunks for food, but at least two species, the kingbird (*Tyrannus tyrannus*) and the western yellow-bellied flycatcher (*Empidonax difficilis*), are known to prey upon the codling moth. No fewer than 15 larvæ were found in the stomach of a bird of the latter species collected at Haywards, Cal., in September.

¹ Insect Life, III, pp. 79-80, Sept., 1890.

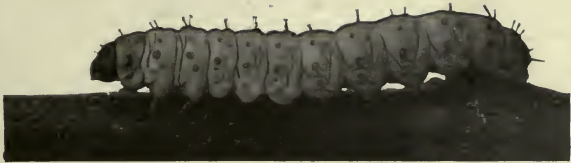
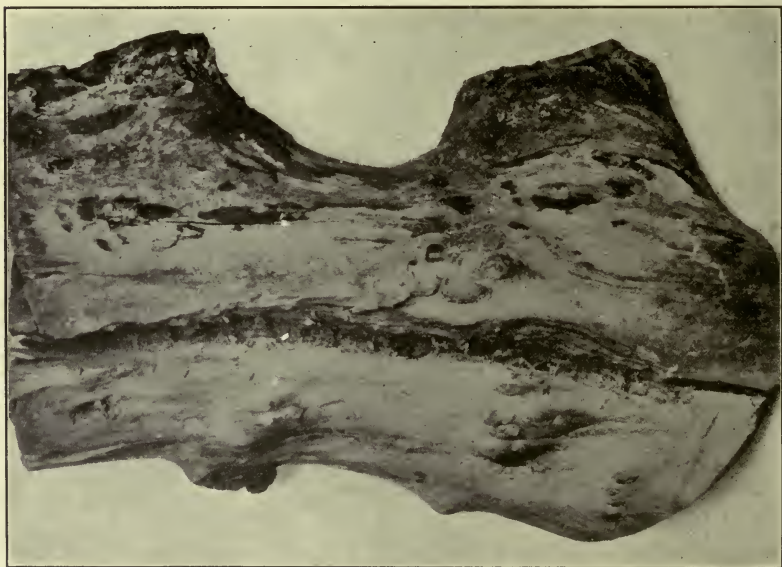


FIG. 1.—LARVA. (3 TIMES NATURAL SIZE.)



FIGS. 2 AND 3.—PUPÆ UNDER BARK SCALES.

LARVA AND PUPÆ OF CODLING MOTH.



HOLES AND CRACKS IN TREES ENLARGED BY WOODPECKERS SEARCHING FOR
CODLING MOTH LARVÆ AND PUPÆ.

THE CROW FAMILY.

The blue jay (*Cyanocitta cristata*), the California jay (*Aphelocoma californica*), and the magpie (*Pica pica hudsonia*) give the crow family representation among codling-moth enemies. It is reported that in the State of Washington magpies frequently tear loosely fastened bands off the trees while searching for the hibernating larvæ.¹ Pupæ of the codling moth have been found in several stomachs of the California jay, collected at Haywards, Cal., in May.

BLACKBIRDS AND ORIOLES.

Three species of this family are on the list of foes of the apple worm, namely, the crow blackbird (*Quiscalus quiscula*), Brewer blackbird (*Euphagus cyanocephalus*), and Bullock oriole (*Icterus bullocki*). Pupæ were found in the stomachs of many Brewer blackbirds collected at Haywards and Watsonville, Cal., in May and June. Twenty-six Bullock orioles taken in the same localities from April to August had eaten enough pupæ and larvæ of the codling moth to make about 20 per cent of their food. One of these birds had taken 14 larvæ and pupæ.

THE SPARROW FAMILY.

Members of this family that prey upon the codling moth are: English sparrow (*Passer domesticus*), chipping sparrow (*Spizella passerina*), California towhee (*Pipilo crissalis*), cardinal (*Cardinalis cardinalis*), black-headed grosbeak (*Zamelodia melanocephala*), and lazuli bunting (*Passerina cyanea*). The adult California towhees, besides eating the pupæ of the codling moth themselves, feed them to their nestlings. Black-headed grosbeaks have the same habit and to such an extent that they rank among the most important enemies of the insect. No fewer than 12 larvæ were found in one stomach and 29 pupæ in another. Twenty-one black-headed grosbeaks collected at Haywards and Watsonville, Cal., in May, had made over 20 per cent of their diet of codling larvæ and pupæ.

SWALLOWS AND VIREOS.

On the Pacific coast the barn swallow (*Hirundo erythrogastra*) is said to catch adult codling moths, but probably its services in this direction have been overstated.

The stomachs of several western warbling vireos (*Vireosylva gilva swainsoni*), taken in California in April, May, and June, contained pupæ of the codling moth.

¹ Melander, A. L., and Jenne, E. L. Bul. 77, Wash. Agr. Exp. Sta., p. 39, 1906.

WARBLERS.

Only two warblers, the summer or yellow warbler (*Dendroica aestiva*) and the lutescent warbler (*Vermivora celata lutescens*), are now known to prey upon codling moths, but it is certain that further study of the food of this much neglected family will add a considerable number of species to the list. The lutescent warbler shows a strong liking for the pupæ, two taken in California in May having eaten 10 and 18 pupæ, respectively.

CREEPERS AND NUTHATCHES.

Each of these families has a single species on the list of enemies of the apple worm, namely, the brown creeper (*Certhia familiaris americana*) and the white-breasted nuthatch (*Sitta carolinensis*). It is reasonable to suppose that all the subspecies of creepers and nuthatches will in time be found to eat codling larvæ and pupæ.

TITMICE AND CHICKADEES.

Next to woodpeckers, titmice are probably the most important enemies of the codling moth. Their habits of searching every nook and cranny, however small or difficult of access, and the thorough way they go over trees and stumps, enable them to find the favorite hibernating quarters of the larvæ. A description of their methods of hunting is given by Trimble, who remarks (p. 120), after detailing that he had taken 5 larvæ from the stomach of a black-capped chickadee (*Penthestes atricapillus*):

The day had been dry and windy, following a warm wet day and night; and it is in just such weather that the bark of the buttonwood, shellbark hickory, and other shaggy trees will be found curling out and falling off.

I have never seen anything that would lead me to believe that this minute bird makes the holes in the scales of bark that lead directly to the cocoons of these caterpillars; they are made by the downy woodpecker and probably by it alone. The chickadee most likely finds these worms only or chiefly on such days as this, when the warping of these scales exposes them to the prying eyes of these busy little friends.

Besides the black-capped chickadee, the following four species of this family are known to eat codling moth larvæ or pupæ: Plain titmouse (*Bæolophus inornatus*), Carolina chickadee (*Penthestes carolinensis*), mountain chickadee (*Penthestes gambeli*), and California bush tit (*Psaltiriparus minimus californicus*).

Ten stomachs of the last-named species, examined by Prof. F. E. L. Beal, contained, on the average, 25 per cent of pupæ of the codling moth. Eight of these stomachs were of nestlings, containing pupæ as follows: Two stomachs contained 2 each, two contained 3 each, one contained 4, one 7, one 9, and one 11, making 41 in all, or an average of over 5 to each.

The economic value of these nestlings is commented upon by Prof. Beal as follows:

The oak tree in which these birds were found was in a belt of timber along a creek, and just across the stream was a considerable area of neglected orchard. It is evident that the parent birds used this orchard as a foraging ground and did their best toward remedying the neglect of the owner. As with nestling birds feeding and digestion are almost continuous during the hours of daylight, it follows that the above record would be several times repeated during a day's feeding. There were probably not less than a dozen nests of the bush tit (several were seen) along the border of this orchard, and if, as is possible, the occupants all did as good work as the ones recorded, it is evident that the birds must exert a powerful restrictive influence upon the increase of the codling moth, as well as other insects.¹

KINGLETS AND THRUSHES.

One species of kinglet, the ruby-crowned (*Regulus calendula*), eats codling larvæ, as do also two species of the thrush family—the robin (*Planesticus migratorius*) and the bluebird (*Sialia sialis*). The robin eats this insect in both the East and the West, and a stomach from Pullman, Wash., contained 11 larvæ.

EFFICIENCY OF BIRD ENEMIES.

We find that in the United States there are 36 species of birds, belonging to 13 families, that feed on the codling moth. The three important families seem to be woodpeckers, titmice, and sparrows. Probably, however, future investigation may place some other family, possibly warblers, among the first three.

We have shown that certain species, as the downy woodpecker, Bullock oriole, black-headed grosbeak, and bush tit, consume large numbers of codling-moth larvæ and pupæ. It is probably only because of insufficient investigation that the same can not be said of other birds. Although we can not accurately rank the species in importance, we can confidently declare their utility collectively.

Almost every entomologist who has written on the subject substantially agrees with Slingerland that "by far the most efficient aids to man in controlling the codling moth are the birds."² The two facts that have chiefly led to this conclusion are the great scarcity of intact hibernating cocoons and the abundance of empty ones which have evidently been rifled by birds. Long ago Walsh and Riley said:³

From the careful inspection of several large orchards in the early spring months, we are convinced that almost all of the cocoons of the apple-worm moth that have been constructed in the autumn on the trunks and limbs of apple trees are gutted of their living tenants by hungry birds long before the spring opens.

¹ Bul. 30, Biol. Survey, pp. 79-80, 1907.

² Bul. 142, Cornell Agr. Exp. Sta., p. 41, 1898.

³ American Entomology, I, p. 113, 1869.

In Virginia "counts of over 400 cocoons observed on apple trees revealed the fact that * * * birds had destroyed fully 85 per cent of the worms."¹

From New Hampshire comes this report:²

Only from 5 to 20 per cent of the larvæ survived the winter. An examination of 7 trees, which averaged over 38 cocoons per tree in the fall, showed but 5 per cent alive in the spring, 87 per cent having been killed by birds, 4 per cent by disease, and 3 per cent by cold. In another orchard 1,096 cocoons were examined in May, 1907, with 19 per cent alive, 66 per cent having been killed by birds, 6 per cent by disease, and 9 per cent by cold. It is quite evident that the birds, particularly the downy woodpeckers and the nuthatches, are the most important enemies of the codling moth in New England and that they should be given every protection and attracted to the orchard in every way possible. * * * They annually save us barrels of apples by destroying the apple worms under the bark in winter. They should therefore be encouraged and allured to the orchard whenever possible. Bits of suet and meat suspended from the trees will often attract them and sometimes help them through a hard winter.

Other measures recommended to aid birds in the warfare on this destructive moth are cementing up cavities suitable for the hibernation of the moth, thus forcing the larvæ to spin cocoons where birds can get them, and scraping off loose flakes of bark, especially those below the snow line, as under these the largest numbers of larvæ survive.

FOREIGN BIRD ENEMIES OF THE CODLING MOTH.

The suggestion has been made that foreign birds with an established reputation as codling-moth destroyers be imported into this country. The bird most frequently mentioned is the great titmouse or Kohlmeise (*Parus major*) of Europe. However, European records fail to show that this bird pays any particular attention to the codling moth. Moreover its food habits, while apparently beneficial on the whole, include some bad traits, such as eating bees, budding trees, attacking pears, and killing smaller birds. Thus the species is distinctly not a promising one for trial in the exceptionally hazardous field of international importation. Among foreign birds that have been definitely recorded as enemies of the codling moth are the European nuthatch (*Sitta cæsia*),³ European wren (*Nannus parvulus*),⁴ tree creeper (*Certhia familiaris*),^{3 4 5} blue titmouse (*Cyanistes cæruleus*),^{3 6} kinglets (*Regulus cristatus* and *Regulus*

¹ Buck, J. E. Ann. Rep. Va. Exp. Sta., p. 55, 1908.

² Sanderson, E. D. New Hampshire Agr. Exp. Sta. Bul. 143, pp. 64 and 82, 1909.

³ Hooper, C. H. Reprint from Country Gentleman's Estate Book, pp. 5 and 16, London, 1907.

⁴ Bos, J. Ritzema. Tierische Schädlinge und Nützlinge, p. 527, Berlin, 1891.

⁵ Hooper, C. H. Agr. Students Gazette, new ser. 13, p. 123, 1907.

⁶ Theobald, F. V. Text-Book of Agr. Zoology, p. 403, London, 1899.

ignicapillus),¹ one of the babblers (*Pomatorhinus superciliosus*),² the white-eye (*Zosterops caeruleascens*),³ and the white-throated tree-creeper (*Climacteris leucophaea*),⁴ of Australia. Woodpeckers and sparrows are said to share in the work in Europe.

With three exceptions these birds belong to the same families as native species which we know devour the codling moth. These families are the creepers (Certhiidae), nuthatches (Sittidae), titmice (Paridae), and kinglets (Sylviidae). The United States already has a sufficient number of species of these families, besides numerous members of other families, which, if properly protected and encouraged, will probably destroy more codling moths than foreign species. To favor the increase and efficiency of our own useful species is not only far more profitable than to introduce foreign ones, but avoids the danger, acknowledged by all authorities as great, of opening our doors to a bird that in its new home may become obnoxious. It is a well-known fact that a very large number of our crop pests, both plant and animal, are imported. Furthermore, it is clear that the fundamental idea underlying proposals for introducing bird enemies of the codling moth is false. This idea is that each pest has some specific enemy or set of enemies which, if introduced, will control it to such a degree that the usual combative measures like spraying can be abandoned. This is a most alluring theory, but it is not borne out by practical experience. Birds exert a constant repressive influence on the number of insects, but those who expect either native or introduced birds to control a widespread insect pest to the degree necessary for the commercial success of the crop attacked will be disappointed.

SUMMARY.

Birds are recognized as the most effective natural enemies of the codling moth. In some localities they destroy from 66 to 85 per cent of the hibernating larvæ, and their work in large measure accounts for the small spring broods of the insect. This annual reduction in numbers of the pest is a very valuable factor in its control.

Thirty-six species of birds are known to prey upon the codling moth in the United States. These species belong to 13 families, of which the most important, so far as number of species on the list is concerned, are the woodpeckers, titmice, and sparrows. Especially valuable species are the downy woodpecker, Bullock oriole, black-headed grosbeak, and bush tit.

¹ Bos, J. Ritzema. Tierische Schädlinge und Nützlinge, p. 527, Berlin, 1891.

² Curnow, S. H. Journ. Agr. S. Australia, p. 20, Aug., 1909.

³ Emu, VII, pt. 1, p. 36, July, 1908.

⁴ Journ. Agr. Victoria, IX, pt. 8, p. 552, Aug., 1911.

At least 10 species of foreign birds have been recorded as enemies of the codling moth, and there has been considerable agitation for the introduction of one or more of them. The importation of foreign species is, however, notoriously dangerous, and if successful would result in crowding out native species probably of greater value.

Exaggerated claims have been made for all sorts of natural enemies of insects, including birds, but all that can be truthfully claimed for them is that their influence is to lower the number of insect pests and hence is for the good. The amount of good done varies in different cases, and admittedly the bird enemies of the codling moth deserve the best protection and encouragement in recognition of their rank as the chief natural enemies of the pest.

• O

F

THE ENGLISH SPARROW AS A PEST.

INTRODUCTION.

DISTRIBUTION.

By U.S. Dept. of Agr.

The English sparrow was introduced into America a little more than 60 years ago, and is now distributed over nearly all of the United States and southern Canada. This rapid dissemination is a result of the bird's hardiness, extraordinary fecundity, diversity of food, aggressive disposition, and almost complete immunity from natural enemies.

ECONOMIC STATUS.

The English sparrow among birds, like the rat among mammals, is cunning, destructive, and filthy. Its natural diet consists of seeds, but it eats a great variety of other foods. While much of its fare consists of waste material from the streets, in autumn and winter it consumes quantities of weed seed and in summer numerous insects. The destruction of weed seed should undeniably count in the sparrow's favor. Its record as to insects in most localities is not so clear. In exceptional cases it has been found very useful as a destroyer of insect pests. For example, during a recent investigation by this bureau of birds that destroy the alfalfa weevil in northern Utah, English sparrows were feeding their nestlings largely on weevil larvæ and cutworms, both of which are very injurious to alfalfa. In this case the sparrows, attracted by grain in the fields and poultry runs and by the excellent nest sites afforded by the thatched roofs of many farm buildings, had left the city and taken up their abode in the country where the weevil outbreak subsequently occurred. Unfortunately, however, farmers can rarely expect such aid against their insect foes. Wherever this bird proves useful, however, it is entitled to protection and encouragement in proportion to its net value.

Under normal conditions its choice of insects is often unfavorable. Out of 522 English sparrow stomachs examined by the Biological Survey,¹ 47 contained noxious insects, 50 held beneficial insects, and

¹ U. S. Department of Agriculture, Division of Economic Ornithology and Mammalogy, Bulletin 1, The English Sparrow in North America, p. 143, 1889. An exhaustive account now out of print.

31 contained insects of little or no importance. The bulletin just referred to shows conclusively that, aside from the destruction of weed seed, there is, in general, very little to be said in the sparrow's favor.

On the other hand much is to be said against the bird. It destroys fruit, as cherries, grapes, pears, and peaches. It also destroys buds and flowers of cultivated trees, shrubs, and vines. In the garden it eats seeds as they ripen, and nips off tender young vegetables, especially peas and lettuce, as they appear above ground. It damages wheat and other grains, whether newly sown, ripening, or in shocks. As a flock of 50 sparrows requires daily the equivalent of a quart of wheat, the annual loss caused by these birds throughout the country is very great. It reduces the numbers of some of our most useful and attractive native birds, as bluebirds, house wrens, purple martins, tree swallows, cliff swallows, and barn swallows, by destroying their eggs and young and by usurping nesting places. It attacks other familiar species, as the robin, wren, red-eyed vireo, catbird, and mocking bird, causing them to desert parks and shady streets of towns. Unlike our native birds whose place it usurps, it has no song, but is noisy and vituperative. It defiles buildings and ornamental trees, shrubs, and vines with its excrement and with its bulky nests.

The evidence against the English sparrow is, on the whole, overwhelming, and the present unfriendly attitude of the public towards it is reflected in our State laws. Nowhere is it included among protected birds.

LOCALIZATION.

Although English sparrows are widely distributed as a species, individuals and flocks have an extremely narrow range, each flock occupying one locality to which its activities are chiefly confined. This fact is favorable to their extermination, for when a place has once been cleared of sparrows some time elapses before it is reoccupied. This tendency to remain on special territory was well shown during a recent experiment with a flock in a small city garden. During the fall steady trapping reduced the resident flock in the garden to a dozen individuals, 274 birds having been trapped. The survivors were poisoned. Though another flock lived in the street just beyond the fence, the garden was sparrow free for three months. In the following spring a few sparrows appeared, but were soon trapped. After this the garden continued throughout the summer without a resident flock, and only rarely was it visited by sparrows from other parts of the neighborhood.

AIDING NATIVE BIRDS AGAINST THE ENGLISH SPARROW.

One of the greatest objections to the English sparrow is its aggressive antagonism toward the small native birds, especially those familiar species which, like itself, build their nests in cavities. Nest



FIG. 1.—English sparrow, male and female, showing the manner in which they take possession of nesting boxes provided for native birds.

boxes provided for bluebirds, martins, or wrens—birds both useful and pleasing—too often fall into the possession of this graceless alien, either by the right of discovery or by piratical assault. Fortunately it is possible to aid the native birds by selecting suitable nest boxes. Thus, a box having an entrance 1 inch in diameter will admit house wrens, but not sparrows. Boxes for larger birds, as

illustrated in figures 2, 3, and 4, may be constructed so that unwelcome tenants can be readily evicted and at the same time acceptable to more desirable species. When a sparrow has had its nest and eggs removed from a box, it not only as a rule seeks another place for its next nest, but is likely to avoid that type of nest box in future.

Figure 2 represents a nest box designed for the interior of a dilapidated building, a hole being cut in an outer wall of the building to form the entrance. The box illustrated in figure 3 is intended to be

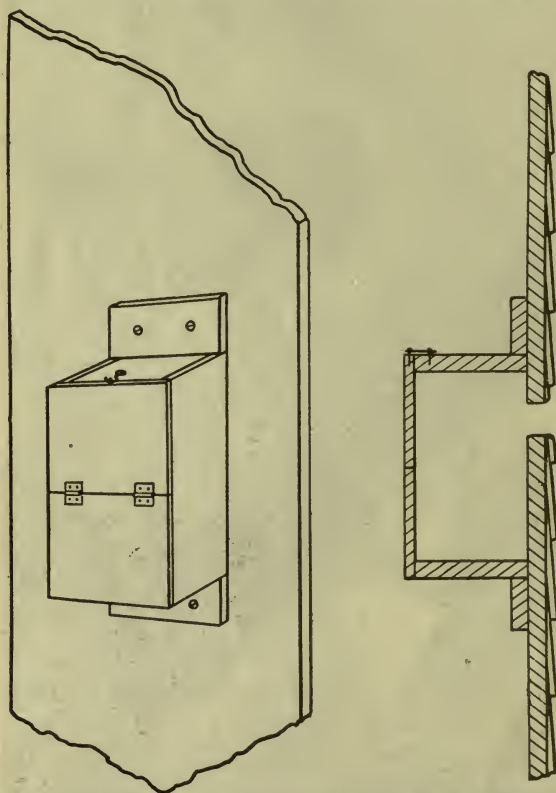


FIG. 2.—Perspective and sectional drawings of an improvised nest box for the interior of buildings.

dislodge sparrow nests. As the cost of such boxes is slight, enough should be provided to accommodate all the resident sparrows at once, in order that their nests may be broken up and the birds compelled to seek other quarters as early in the breeding season as possible. All nest boxes designed to be occupied by native birds should be carefully built to avoid warping of parts and consequent drafts of air.

DRIVING SPARROWS FROM ROOSTS.

Sparrows frequently become a nuisance by roosting in ornamental vines and in crevices about buildings. If scared out late at night, several nights in succession, they will usually desert the roost. A stream of water from a garden hose is a potent ejector, particularly on frosty nights. Where water is not available small Roman candles may be employed.

Though sparrows may be driven from a given neighborhood, the relief thus obtained is only temporary, and has the further objection that the nuisance is simply transferred elsewhere. More drastic action is therefore preferable.

PREVENTION OF INCREASE.

The most effective method of preventing the increase of sparrows in a locality is to destroy their nests at intervals of 10 or 12 days throughout the breeding season. In a town of 4,000 inhabitants, where this method of attack has been practiced during the past four years, 20,000 eggs have been destroyed and the number of sparrows has been greatly reduced. This work, however, should not be entrusted to boys or persons unfamiliar with the native species, as otherwise valuable birds may be destroyed under the belief that they are English sparrows. Occasionally they build large covered nests in trees, but as a rule they build open nests in bird houses, electric-light hoods, cornices, waterspouts, and similar places. While it is often difficult to reach nests by hand, they can usually be torn down by means of a long pole having an iron hook at the tip. By concerted and continuous efforts to destroy every nest after the eggs are laid, the numbers of English sparrows in any locality may be rapidly reduced.

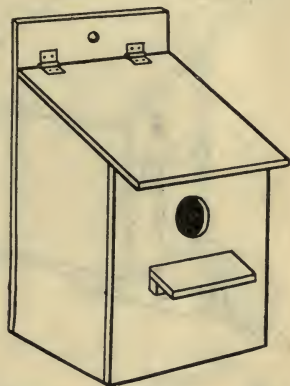


FIG. 3.—Nest box opening at the top.

METHODS OF DESTROYING.

CATCHING ON NESTS.

The sparrow's habit of nesting in cavities can be turned to account against it. By providing one-room bird houses, similar to those illustrated in figures 3 and 4, or even packing boxes or tin cans, and putting them in trees or on poles or buildings at a height of about 10 feet, the birds may be captured after dark with a long-handled

net. The net should have a deep bag and a small hoop. After the net has been quietly placed over the entrance, a few raps on the box will send the occupant into it. By distributing a number of nest boxes about orchards, shade trees, and outbuildings, and catching the sparrows that occupy them, the work of extermination may be carried on at a season when other methods are least effective.

SHOOTING.

Sparrows are accustomed to feed in close flocks, and when thus assembled in favorable places a large number may be killed by a charge of No. 10 shot. The best way is to scatter grain over long, narrow areas and shoot the sparrows at these baiting places. Where sparrows infest poultry yards, the bait may be placed on a horizontal board, supported at such an elevation that the birds can be shot without danger to the poultry.

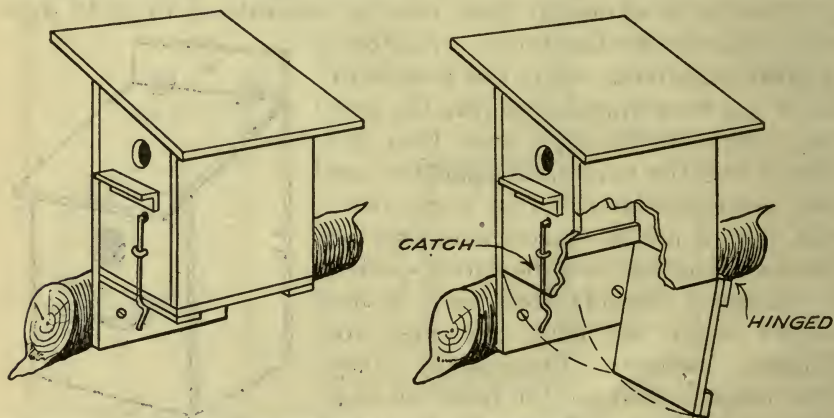


FIG. 4.—Perspectives of a nest box opening at the bottom.

TRAPPING.

In a general campaign against English sparrows, a vigorous and widespread attack is absolutely essential. The problem is not to drive them away from a certain locality, but to accomplish as nearly as possible their complete extermination. As each city square has a sparrow population of its own, which must be destroyed there if at all, certain effective methods of destruction are out of the question. Neither law nor public sentiment will allow the use of firearms or the unrestricted use of poison. The use of traps therefore is strongly recommended. Besides being safe to employ, properly designed sparrow traps have other advantages. They permit the use of sparrows for food, as they leave the flesh uninjured, and these birds may be kept alive, like poultry. The fact that native birds, when caught in such traps, can be liberated unharmed, is particularly important in suburban localities.

Sparrow traps may be classified, according to their nature, as nest-box traps and bait traps. Inasmuch as sparrows usually feed in flocks, but approach nest boxes only singly or in pairs, the annual catch of a bait trap will exceed that of a nest-box trap many fold. During the breeding season, however, nest-box traps are decidedly useful.

NEST-BOX TRAPS.

A nest-box trap, as its name implies, looks like an ordinary nest box. The weight of a bird entering such a trap puts into operation a mechanism which catches the bird and sets the trap for another. There are a number of devices to accomplish this. In designing a nest-box trap one should bear in mind that English sparrows, like other birds, dislike drafty quarters, and that a mechanism delicate enough to be operated by a sparrow's weight is likely to get out of order unless the parts are few and well protected from the weather.

Tesch trap.—Probably the simplest nest-box trap yet designed is the one illustrated by figure 5. The trap described below is a modification of the one invented by Mr. Charles H. Tesch, of Milwaukee, Wis., who furnished plans of his trap and kindly placed at our disposal the results of his experiments. With his trap Mr. Tesch caught sparrows bent on finding a home as fast as they came along. The essential parts of the trap are: (1) A box, (2) a tipping chamber within the box, (3) a down spout below it, and (4) a bag at the lower end of the down spout. The dimensions of the several parts are given in figure 6. The tipping chamber is made of tin, the down spout of wood or tin, the box of wood. The roof board is cleated across the ends, and also lengthwise between the cross cleats, for the attachment of the sides, as shown in the right-hand drawing, figure 6. The close weave of a 2-bushel bag makes it suitable for the lower end of the down spout. One of coarser fabric would allow a draft through the spout and thus detract from the efficiency of the trap. In building this trap the front wall is the last piece to go in place. It is fastened there by screws, so the trap can easily be overhauled. It is a good plan to fasten with shellac a few feathers or bits of hay

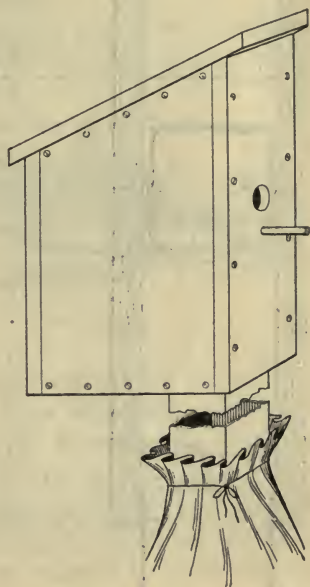


FIG. 5.—Tesch nest-box trap.

to the floor of the tipping chamber near the rear end to excite the interest of sparrows and hasten their entrance.

BAIT TRAPS.

The selection of a bait trap depends somewhat upon the conditions under which it is to be used. Where food is plenty, as in stable yards, poultry runs, and open markets, sparrows have no incentive to

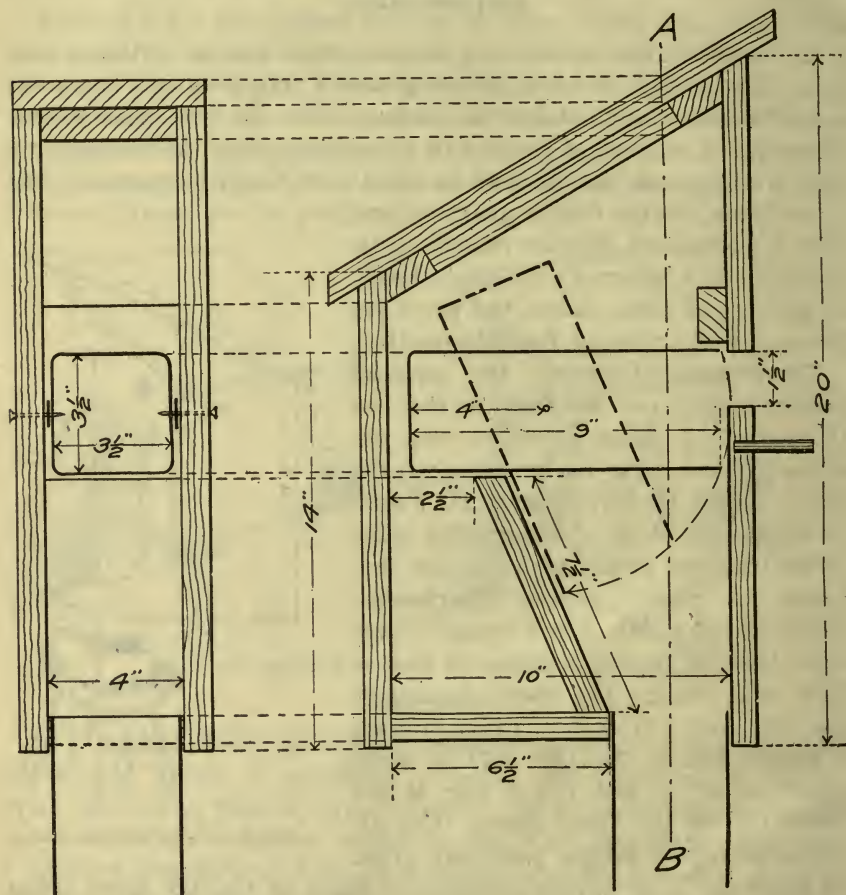


FIG. 6.—Sections showing construction of Tesch nest-box trap.

run risks; and under such circumstances a trap to be effective must be simple so as not to excite suspicion.

Sieve Trap.—The sieve trap shown in figure 7 is adapted for service where food is abundant. In the duck yards of the National Zoological Park, Washington, D. C., it is the only trap that has proved successful. It consists of a shallow box not less than 4 feet square, open on one side, covered with woven wire on the other, and having a small door near one corner. In setting this trap, one side

rests on the ground, which is carefully smoothed where the trap will fall, while the opposite side is supported by a stick 18 inches long. Near the upper end of this stick is attached a long cord, and between the top of it and the edge of the trap (see fig. 7) is placed a chip. By setting the trap over bait and pulling the cord from a sheltered point of observation numbers may be caught. Instead of the box described above, by which the birds are taken alive, an old door or similar device may be employed as a deadfall. In either case the trap should be kept set and baited until the sparrows are not afraid to go under it. During this interval, to avoid accidents to creatures for which it is not intended, as well as to insure stability, it may be supported by a stake driven into the ground instead of by the stick used to spring it. Although the sieve trap is easy to construct and effective in operation, it has the disadvantage that someone must be on hand to pull the string at the proper instant.

Miller Trap.—The trap shown in figures 8, 9, and 10 was designed by Mr. Charles W. Miller, director of the Worthington Society for the Study of Bird Life, who has kindly furnished photographs and drawings showing its construction and has given suggestions for operating it. With one of these traps over

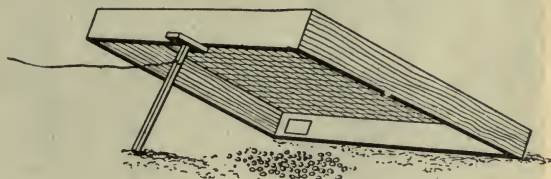


FIG. 7.—Sieve trap.

300 sparrows were caught in less than three months on the society's grounds at Shawnee on Delaware, Pa. It is especially adapted to poultry and pigeon yards, where it can be permanently installed. The poultry or pigeons are fed in the trap, the door being left open until sparrows are accustomed to feed there with them. Later the door is closed and by putting a little bait on the shelf and considerable on the ground inside, the sparrows are enticed to enter through the open corners at the top (fig. 10-*a*). After they have learned the way in and out over the shelf, the corners are closed. The sparrows now enter between the partitions (fig. 10-*b*, *b*) and are unable to return. Captives are removed from this trap by means of a short-handled net, from which they can be taken by hand. A few birds should be left in the cage as decoys. Captives are removed and the decoys supplied with food and water at dusk when outside birds are at roost.

The construction of the Miller trap may be described under four heads: (1) The cage; (2) the frame, (3) the partitions, and (4) the shields. Figure 10 shows the skeleton of this trap without the wire

netting. This should be painted green or gray before the netting is applied. Regular aviary netting of 1 by $\frac{3}{4}$ inch mesh, or poultry netting of $\frac{3}{4}$ -inch mesh, may be used. The door has a hook on each side and spring hinges. Around the top of the cage extends a shelf (fig. 10-*c*) about 8 inches wide.

The underside of the frame (fig. 10-*d*) is perfectly flat all the way around, in order that the partitions may be attached at a uniform height. The ends of two opposite sides extend 6 inches beyond the square to allow the supporting blocks to be placed where they will not hinder the entrance of sparrows when the corners are open

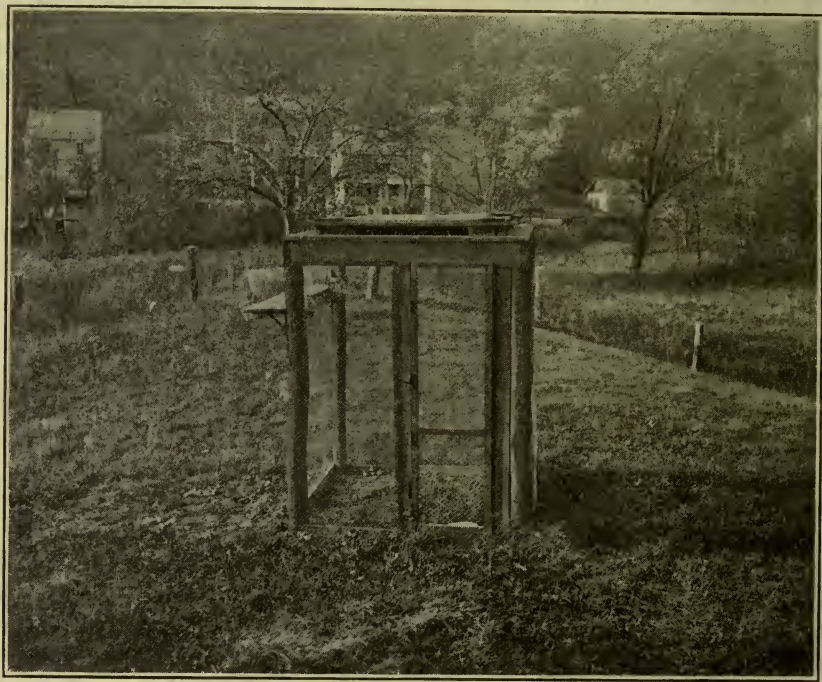


FIG. 8.—Miller trap.

(fig. 10-*f*). The outside measurement of the frame is an inch larger all the way around than the inside measurements of the shelf. After the frame has been painted and covered with wire on the uneven side, it is placed in its final position with relation to the shelf, but without the supporting blocks, and is marked by a pencil drawn along the inner edge of the shelf to show the position for the outer edges of the partitions.

The partitions are sheets of tin 5 inches wide and 6 inches long, having a flap turned over at the top for attachment to the frame and another flap on the outer edge for attachment to the shelf (fig. 10-*b*).

As the sides of the frame are 6 inches wide and the shelf extends inward beneath them 1 inch, the inner edges of the partitions will come even with the inner edge of the frame. The partitions are first nailed to the frame, 2 inches apart, beginning at the middle of each side. The side flaps are nailed to the shelf after the frame has been fastened in position on the corner blocks, which are $2\frac{1}{2}$ inches high. The entrances are thus 2 inches wide and $2\frac{1}{2}$ inches high. The shields are strips of tin nailed to the inner edge of the frame, and extending below it $4\frac{1}{2}$ inches in contact with the inner edges of the partitions, to prevent sparrows in the trap from escaping (fig. 10-*e*). Both

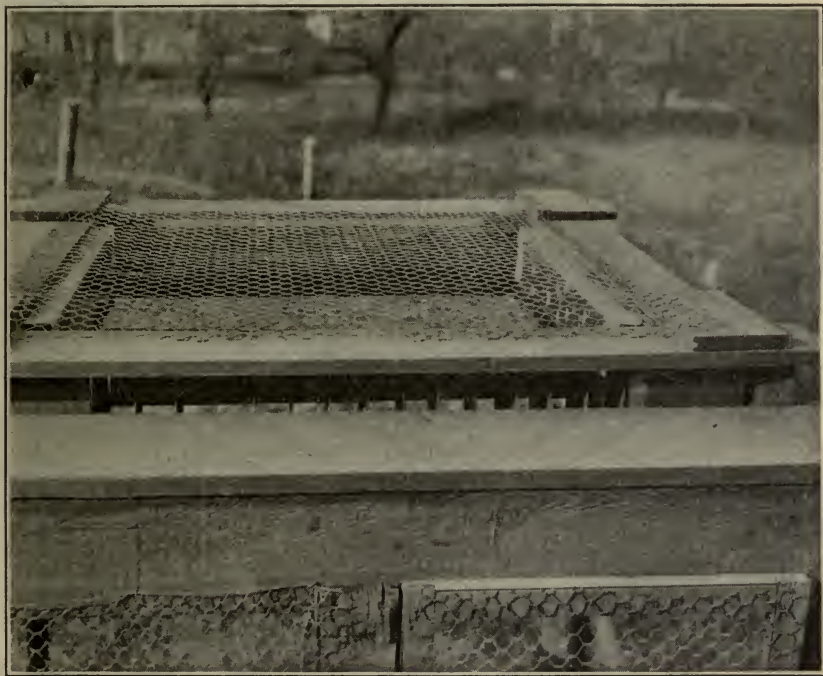


FIG. 9.—Top of Miller trap.

shields and partitions should be painted to prevent rusting. The corners between the series of entrances (fig. 10-*a*) are closed by pieces of tin or thin board hinged or otherwise arranged so as to be easily opened when sparrows are to be enticed to enter.

In case several traps are to be built, it will be advantageous to use unit trap tins (fig. 10-*Ak*), held in place by way plates (fig. 10-*Al*), instead of separate partitions and shields. In this case, as unit trap tins can be removed from a way plate at any time, the corners may be closed permanently by the blocks supporting the frame, the projecting ends thus being unnecessary.

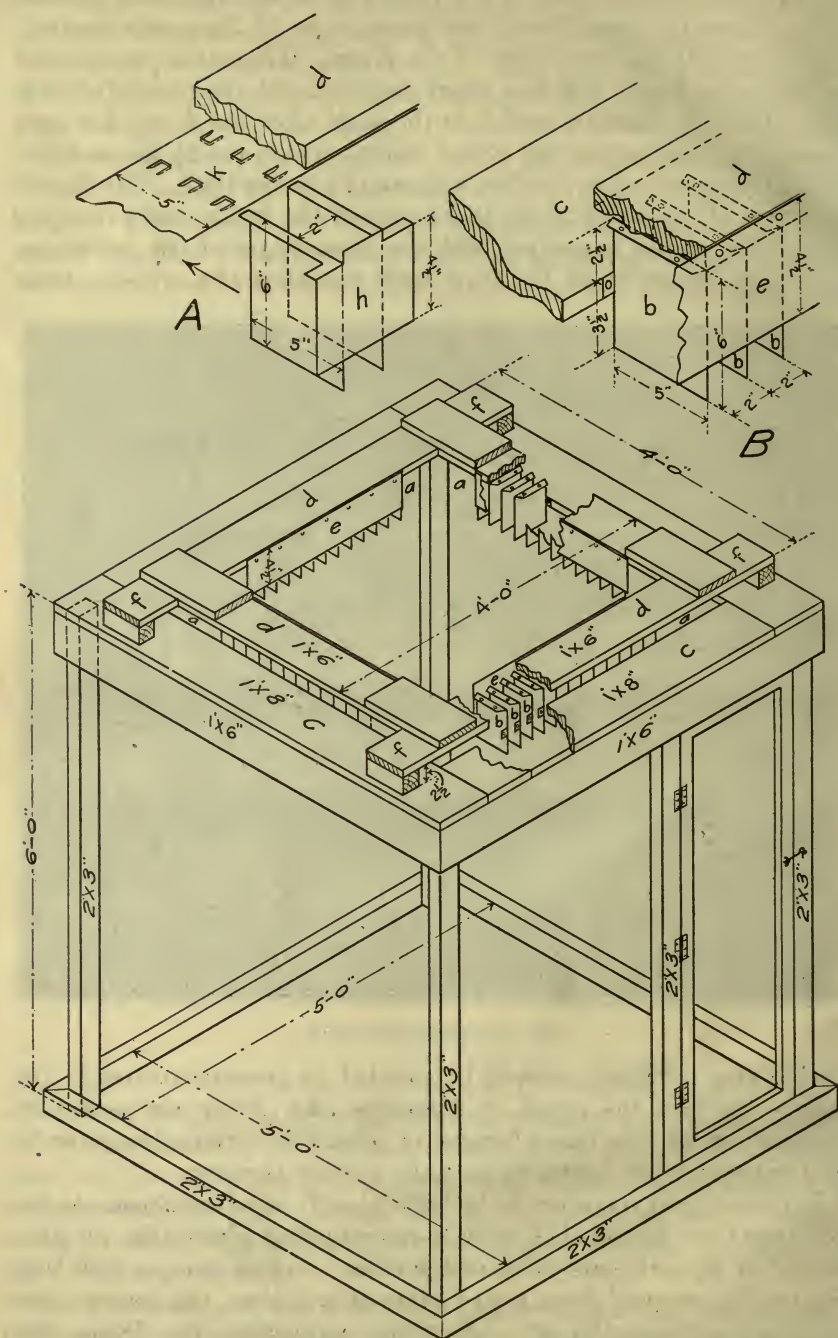


FIG. 10.—Details of Miller trap.

Funnel trap.—When extensive trapping is undertaken, the traps employed must fulfill certain requirements in addition to ultimate efficiency. Especially important are simple and prompt action, portability, and cheapness, all of which are found in the funnel trap.

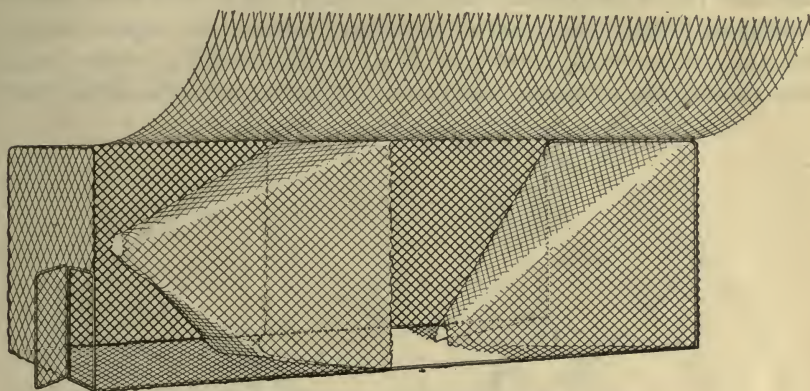


FIG. 11.—Funnel trap. (Side raised to show interior.)

(Fig. 11.) Numerous experiments show that funnel traps usually make a catch on the first day they are set. This trap has no loose parts to become disarranged and requires no tools to keep it in order. Although somewhat bulky, it weighs but little, and when painted

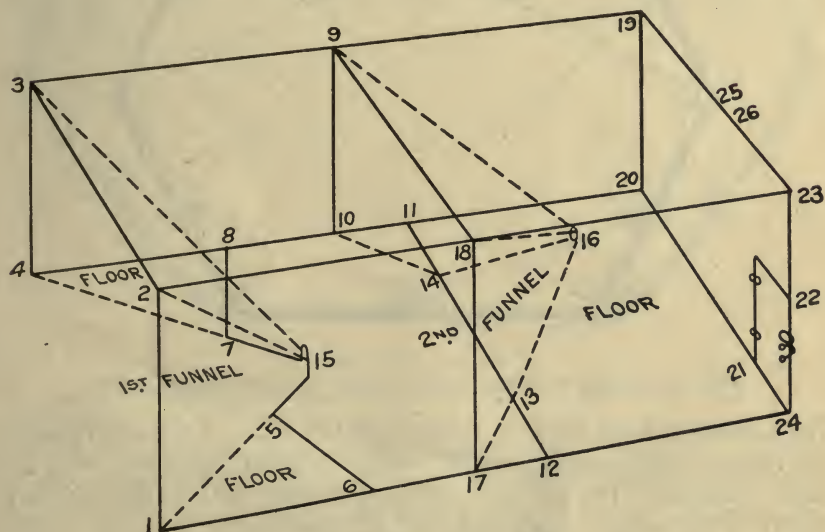


FIG. 12.—Outline of funnel trap.

green or gray is inconspicuous. It is easy to construct, and the cost of material is slight. The funnel trap has been tested on the Agricultural Grounds in Washington with excellent results, and one sent for trial to the Missouri Botanical Gardens at St. Louis during the

past summer caught 300 sparrows in six weeks. Its usefulness in a city garden has already been referred to under "Localization."

The essential parts of this trap are: (1) A half funnel leading into (2) an antechamber, which ends in (3) a complete funnel leading into (4) a final chamber. It is made of woven-wire poultry netting of $\frac{3}{4}$ -inch mesh and is reenforced around the open end and along the sides at the bottom by No. 8 or No. 10 wire, which is used also around the aperture for the door and around the door itself.

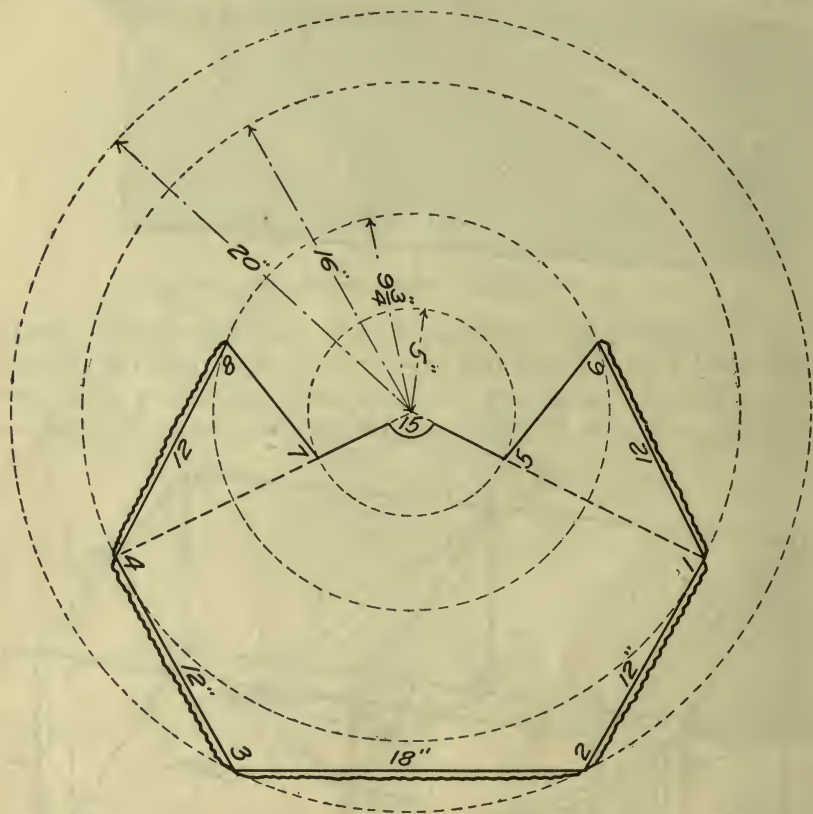


FIG. 13.—Pattern for first funnel of a trap to be 36×18×12 inches.

The angles between the first funnel and the walls of the antechamber are floored with netting, and the final chamber is floored with the same material. The accompanying drawings will enable anybody handy with tools to construct one of these traps in a few hours. These plans are for a trap 3 feet long, a foot and a half wide, and a foot high. At ordinary retail prices the cost of material will be about 70 cents. Paper patterns for the two funnels can be made by first drawing the concentric circles, as shown in figures 13 and 14, and then laying off the straight lines, beginning with the longest.

The wavy outlines indicate that the pattern is to be cut half an inch outside of the straight lines to allow extra wire for fastening the cones to the top and sides of the trap. Figure 15 shows how all the parts of a trap having the above dimensions may be cut from a piece of netting 4 feet wide and 6 feet long. The full lines in this figure indicate where the netting is to be cut and the broken lines where it is to be bent. The numbers at the angles in figures 13, 14, and 15 correspond with those in figure 12, which shows in outline the rela-

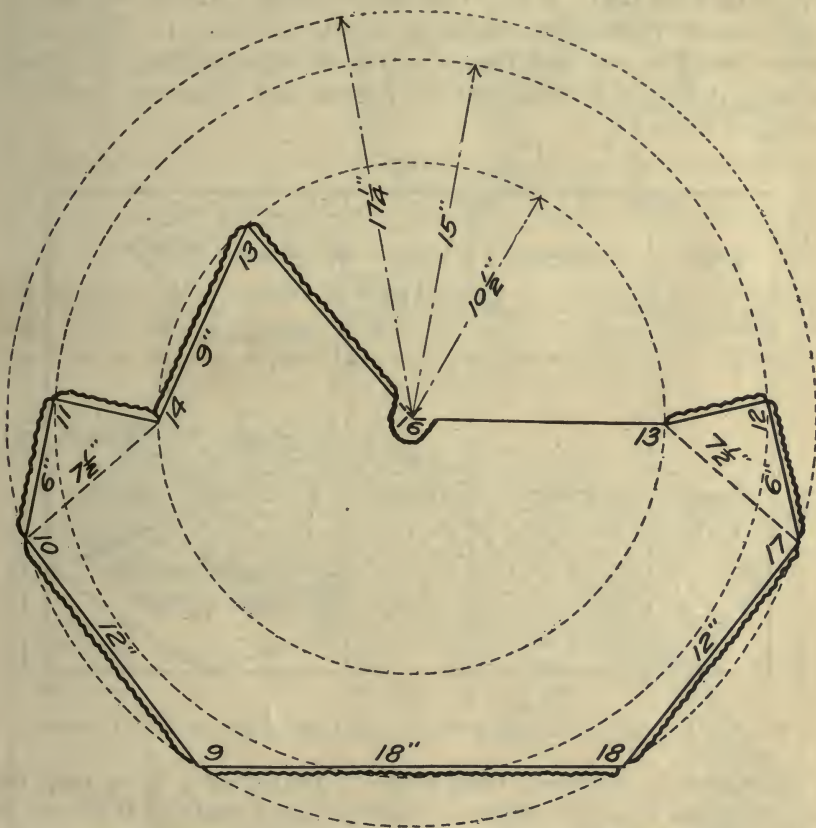


FIG. 14.—Pattern for second funnel of a trap to be 36×18×12 inches.

tion of the different parts as they appear when assembled. A trap of the above dimensions is as small as can be used satisfactorily. Where sparrows are very numerous a larger size is recommended. Figure 16 shows how a trap 4 feet long, 2 feet wide, and 15 inches high may be made from a piece of netting 4 by 10 feet. This is a very good size for parks and large private grounds.

In setting a funnel trap a place should be selected where sparrows are accustomed to assemble. Often there are several such places in

a neighborhood, in which case it is advisable to move the trap daily from one of them to another, because the birds appear to associate the locality rather than the trap with the distress of their imprisoned comrades. Canary seed, hemp seed, wheat, oats, and bread crumbs are excellent baits. The bait should be scattered in the antechamber and first funnel and also, sparingly, outside about the entrance. A live sparrow kept in the trap as a decoy will facilitate a catch. In case native birds enter a trap they may be released without harm. Trapping may begin at any time after young sparrows are able to take care of themselves, which is usually by July 1. Each day's catch should be removed from the trap at nightfall, and if a decoy is used it should be comfortably housed and otherwise cared for when off duty.

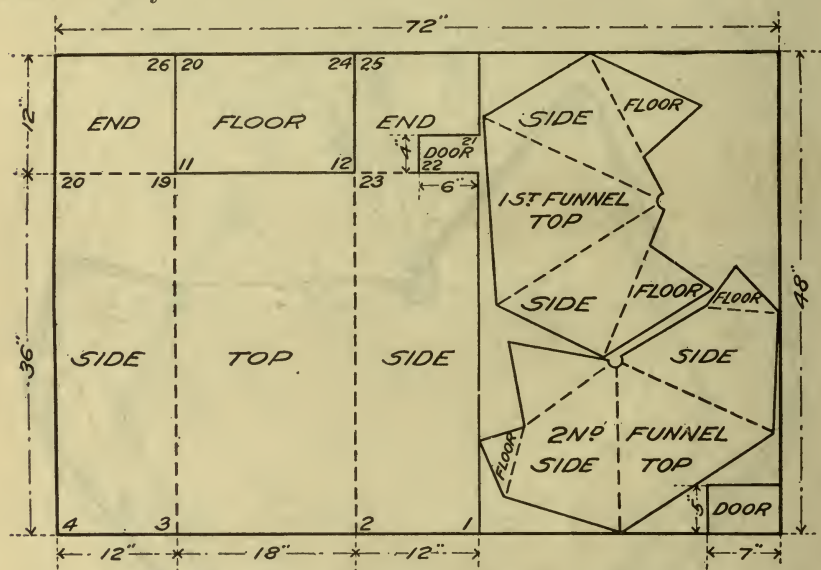


FIG. 15.—Diagram for cutting out the parts of a funnel trap 36×18×12 inches.

In removing sparrows from either a funnel or a sieve trap the receiving box shown in figure 17 will be found useful. It should be about 6 inches square and 18 inches long, inside measurement. The door, hinged at the bottom and turning inward, is controlled by the part of its wire frame extending through the side of the box to form a handle. The box as it appears in the figure is ready to be placed before the open door of a trap from which birds are to be driven.

POISONING.

Where the use of poison is not prohibited by law it may be employed effectively to reduce the number of sparrows. Of the different poisons tested the most satisfactory is strychnine, which is

easy to prepare and acts quickly. Wheat has proved to be a good bait as well as an excellent vehicle for administering the drug. A convenient method of preparing poisoned bait is as follows: Put one-eighth ounce of pulverized strychnine into three-fourths of a gill of

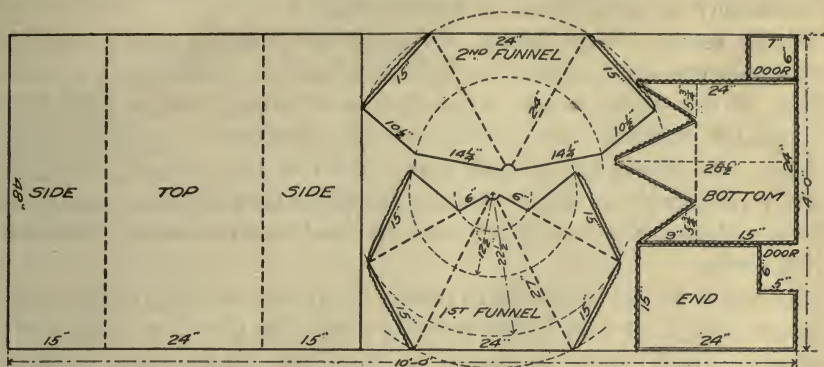


FIG. 16.—Diagram for cutting out the parts of a funnel trap 48×24×15 inches.

hot water, add $1\frac{1}{2}$ teaspoonfuls of starch or wheat flour moistened with a few drops of cold water, and heat, stirring constantly till the mixture thickens. Pour the hot poisoned starch over 1 quart of

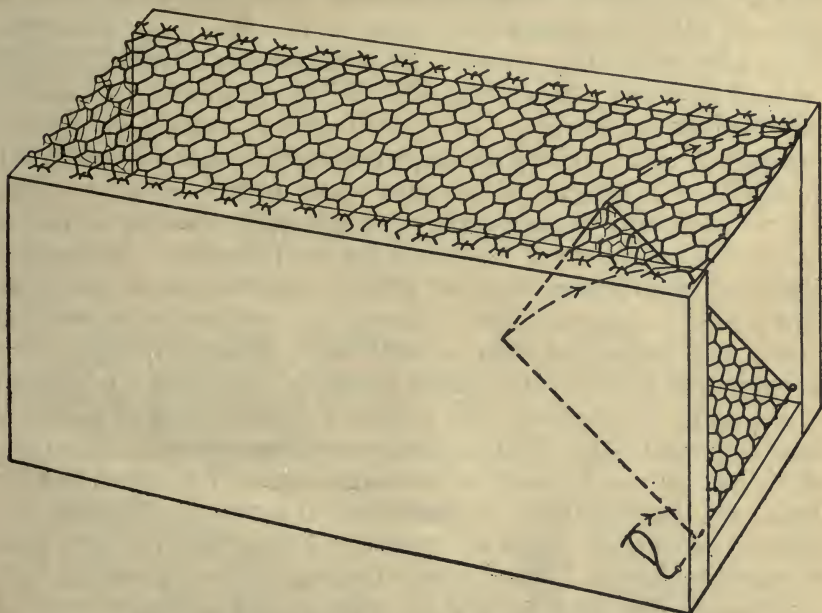


FIG. 17.—Receiving box for removing sparrows from traps.

wheat and stir until every kernel is coated. Small-kerneled wheat sold as poultry food, if reasonably clean, is preferable to first-quality grain, being cheaper and more easily eaten by the sparrows. A 2-quart glass fruit jar is a good vessel to mix in, as it is easily shaken

and allows the condition of the contents to be seen. If the coated wheat be spread thinly on a hard, flat surface, it will be dry enough for use in a short time. It should be dried thoroughly if it is to be put into jars and kept for future use. Dishes employed in preparing poison may be safely cleansed by washing.

Other seeds, as oats, hemp, or canary seed, may be used instead of wheat in the above formula, but they are less economical because much of the poison is lost when they are hulled, though enough of it usually sticks to the mouths of the sparrows to produce fatal effects. As wheat has no hull that a sparrow can remove, it is ordinarily preferable to other seeds. Bread, in thin slices, spread with the strychnine-starch mixture may be used to advantage alternately with seeds.

In case it is impracticable to poison sparrows at their regular feeding grounds, they may be attracted to a suitable place by preliminary baiting. In northern latitudes the best time to put out poison is just after a snowstorm, when other food is covered. The feeding place should be cleared of snow and the poison laid early in the morning. The poison should be well scattered, so that many birds may be able to partake at the same time, since after a few are affected their actions excite the suspicion of their comrades. Usually a few sparrows get only enough strychnine to paralyze them for a few hours, after which they recover. It is important, therefore, to visit the feeding places a short time after distributing poison to prevent such birds from escaping. It is well also to remove dead birds promptly to avoid exciting the suspicious of those that are unaffected. In deciding the amount of poisoned wheat to put out at one time, it is well to estimate the number of sparrows frequenting a feeding place and to allow about 20 kernels for each sparrow. Although 2 kernels of wheat coated with the solution described below have been known to kill a sparrow, 6 or 7 kernels are required to insure fatal results, and much more than a fatal dose is frequently taken. The sparrows that recover after taking poison or that become frightened by the death of comrades, will forsake a feeding place if poison is kept there constantly. If, therefore, one wishes merely to keep them off his land, he can do so by maintaining a supply of poisoned bait for them. On the other hand, if extermination is the object sought, unpoisoned bait should be put out after each killing until the birds have recovered confidence. There is an advantage in having several feeding grounds that may be used in rotation with different kinds of bait. Under these circumstances the sparrows forget their fear of each feeding ground while the others in turn are baited. Only as much poison should be put out as is likely to be eaten in one day, since exposure to moisture reduces its virulence. Any grain coated

CONTENTS.

	Page.
Introduction.....	5
Distribution.....	5
Economic status.....	5
Localization.....	6
Aiding native birds against the English sparrow.....	7
Driving sparrows from roosts.....	9
Prevention of increase.....	9
Methods of destroying.....	9
Catching on nests.....	9
Shooting.....	10
Trapping.....	10
Nest-box traps.....	11
Tesch trap.....	11
Bait traps.....	12
Sieve trap.....	12
Miller trap.....	13
Funnel trap.....	17
Poisoning.....	20
English sparrows as food.....	23
Summary.....	24

ILLUSTRATIONS.

	Page.
FIG. 1. English sparrows.....	7
2. Nest box for the interior of buildings.....	8
3. Nest box opening at the top.....	9
4. Nest box opening at the bottom.....	10
5. Tesch nest-box trap.....	11
6. Sections showing construction of Tesch nest-box trap.....	12
7. Sieve trap.....	13
8. Miller trap.....	14
9. Top of Miller trap.....	15
10. Details of Miller trap.....	16
11. Funnel trap.....	17
12. Outline of funnel trap.....	17
13. Pattern for first funnel.....	18
14. Pattern for second funnel.....	19
15. Diagram for cutting out the parts of a funnel trap 36 by 18 by 12 inches.....	20
16. Diagram for cutting out the parts of a funnel trap 48 by 24 by 15 inches.....	21
17. Receiving box for removing sparrows from traps.....	21



Issued April 8, 1911.

United States Department of Agriculture,

BUREAU OF BIOLOGICAL SURVEY—Circular No. 79,

HENRY W. HENSHAW, Chief of Bureau.

OUR VANISHING SHOREBIRDS.

By W. L. MCATEE, *Assistant, Biological Survey.*

The term shorebird is applied to a group of long-legged, slender-billed, and usually plainly colored birds belonging to the order Limicolæ. More than 60 species of them occur in North America. True to their name they frequent the shores of all bodies of water, large and small, but many of them are equally at home on plains and prairies.

Throughout the eastern United States shorebirds are fast vanishing. While formerly numerous species swarmed along the Atlantic coast and in the prairie regions, many of them have been so reduced that extermination seems imminent. The black-bellied plover or beetlehead, which occurred along the Atlantic seaboard in great numbers years ago, is now seen only as a straggler. The golden plover, once exceedingly abundant east of the Great Plains, is now rare. Vast hordes of long-billed dowitchers formerly wintered in Louisiana; now they occur only in infrequent flocks of a half dozen or less. The Eskimo curlew within the last decade has probably been exterminated and the other curlews greatly reduced. In fact, all the larger species of shorebirds have suffered severely.

So adverse to shorebirds are present conditions that the wonder is that any escape. In both fall and spring they are shot along the whole route of their migration north and south. Their habit of decoying readily and persistently, coming back in flocks to the decoys again and again, in spite of murderous volleys, greatly lessens their chances of escape.

The breeding grounds of some of the species in the United States and Canada have become greatly restricted by the extension of agriculture, and their winter ranges in South America have probably been restricted in the same way.

Unfortunately, shorebirds lay fewer eggs than any of the other species generally termed game birds. They deposit only three or four eggs, and hatch only one brood yearly. Nor are they in any wise immune from the great mortality known to prevail among the smaller birds. Their eggs and young are constantly preyed upon during the breeding season by crows, gulls, and jaegers, and the far northern country to which so many of them resort to nest is subject to sudden cold storms, which kill many of the young. In the more temperate climate of the United States small birds, in general, do not bring up more than one young bird for every two eggs laid. Sometimes the proportion of loss is much greater, actual count revealing a destruction of 70 to 80 per cent of nests and eggs. Shorebirds, with sets of three or four eggs, probably do not on the average rear more than two young for each breeding pair.

It is not surprising, therefore, that birds of this family, with their limited powers of reproduction, melt away under the relentless warfare waged upon them. Until recent years shorebirds have had almost no protection. Thus, the species most in need of stringent protection have really had the least. No useful birds which lay only three or four eggs should be retained on the list of game birds. The shorebirds should be relieved from persecution, and if we desire to save from extermination a majority of the species, action must be prompt.

The protection of shorebirds need not be based solely on esthetic or sentimental grounds, for few groups of birds more thoroughly deserve protection from an economic standpoint. Shorebirds perform an important service by their inroads upon mosquitoëes, some of which play so conspicuous a part in the dissemination of diseases. Thus, nine species are known to feed upon mosquitoes, and hundreds of the larvæ or "wigglers" were found in several stomachs. Fifty-three per. cent of the food of 28 northern phalaropes from one locality consisted of mosquito larvæ. The insects eaten include the salt-marsh mosquito (*Aedes sollicitans*), for the suppression of which the State of New Jersey has gone to great expense. The nine species of shorebirds known to eat mosquitoes are:

Northern phalarope (<i>Lobipes lobatus</i>).	Baird sandpiper (<i>Pisobia bairdi</i>).
Wilson phalarope (<i>Steganopus tricolor</i>).	Least sandpiper (<i>Pisobia minutilla</i>).
Stilt sandpiper (<i>Micropalama himantopus</i>).	Semipalmated sandpiper (<i>Ereunetes pusillus</i>).
Pectoral sandpiper (<i>Pisobia maculata</i>).	Killdeer (<i>Oryechus vociferus</i>).
	Semipalmated plover (<i>Aegialitis semipalmata</i>).

Cattle and other live stock also are seriously molested by mosquitoëes as well as by another set of pests, the horse-flies. Adults and



FIG. 1.—Killdeer (*Oxyechus vociferus*.)

larvæ of these flies have been found in the stomachs of the dowitcher, the pectoral sandpiper, the hudsonian godwit, and the killdeer. Two species of shorebirds, the killdeer and upland plover, still further befriend cattle by devouring the North American fever tick.

Among other fly larvæ consumed are those of the crane flies (leatherjackets) devoured by the following species:

Northern phalarope (<i>Lobipes lobatus</i>).	Pectoral sandpiper (<i>Pisobia maculata</i>).
Wilson phalarope (<i>Steganopus tricolor</i>).	Baird sandpiper (<i>Pisobia bairdi</i>).
Woodcock (<i>Philohela minor</i>).	Upland plover (<i>Bartramia longicauda</i>).
Jacksnipe (<i>Gallinago delicata</i>).	Killdeer (<i>Oxyechus vociferus</i>).

Crane-fly larvæ are frequently seriously destructive locally in grass lands and wheat fields. Among their numerous bird enemies, shorebirds rank high.

Another group of insects of which the shorebirds are very fond is grasshoppers. Severe local infestations of grasshoppers, frequently involving the destruction of many acres of corn, cotton, and other crops, are by no means exceptional. Aughey found 23 species of shorebirds feeding on Rocky Mountain locusts in Nebraska, some of them consuming large numbers, as shown below.

- 9 killdeer stomachs contained an average of 28 locusts each.
- 11 semipalmated plover stomachs contained an average of 38 locusts each.
- 16 mountain plover stomachs contained an average of 45 locusts each.
- 11 jacksnipe stomachs contained an average of 37 locusts each.
- 22 upland plover stomachs contained an average of 36 locusts each.
- 10 long-billed curlew stomachs contained an average of 48 locusts each.

Even under ordinary conditions grasshoppers are a staple food of many members of the shorebird family, and the following species are known to feed on them:

Northern phalarope (<i>Lobipes lobatus</i>).	Upland plover (<i>Bartramia longicauda</i>).
Avocet (<i>Recurvirostra americana</i>).	Buff-breasted sandpiper (<i>Tryngites subruficollis</i>).
Black-necked stilt (<i>Himantopus mexicanus</i>).	Spotted sandpiper (<i>Actitis macularia</i>).
Woodcock (<i>Philohela minor</i>).	Long-billed curlew (<i>Numenius americanus</i>).
Jacksnipe (<i>Gallinago delicata</i>).	Black-bellied plover (<i>Squatarola squatarola</i>).
Dowitcher (<i>Macrorhamphus griseus</i>).	Golden plover (<i>Charadrius dominicus</i>).
Robin snipe (<i>Tringa canutus</i>).	Killdeer (<i>Oxyechus vociferus</i>).
White-rumped sandpiper (<i>Pisobia fus-cicollis</i>).	Semipalmated plover (<i>Ægialitis semi-palmata</i>).
Baird sandpiper (<i>Pisobia bairdi</i>).	Ringed plover (<i>Ægialitis hiaticula</i>).
Least sandpiper (<i>Pisobia minutilla</i>).	Mountain plover (<i>Podasocys montanus</i>).
Marbled godwit (<i>Limosa fedoa</i>).	Turnstone (<i>Arenaria interpres</i>).
Yellowlegs (<i>Totanus flavipes</i>).	
Solitary sandpiper (<i>Helodromas solitarius</i>).	



FIG. 2.—Yellowlegs (*Totanus flavipes*).

Shorebirds are fond of other insect pests of forage and grain crops, including the army worm, which is known to be eaten by the killdeer and spotted sandpiper; also cutworms, among whose enemies are the avocet, woodcock, pectoral and Baird sandpipers, upland plover, and killdeer. Two caterpillar enemies of cotton, the cotton worm and the cotton cutworm, are eaten by the upland plover and killdeer. The latter bird feeds also on caterpillars of the genus *Phlegethontius*, which includes the tobacco and tomato worms.

The principal farm crops have many destructive beetle enemies also, and some of these are eagerly eaten by shorebirds. The boll weevil and clover-leaf weevil are eaten by the upland plover and killdeer, the rice weevil by the killdeer, the cowpea weevil by the upland plover, and the clover-root curculio by the following species of shorebirds:

Northern phalarope (<i>Lobipes lobatus</i>).	White-rumped sandpiper (<i>Pisobia fus-</i>
Pectoral sandpiper (<i>Pisobia maculata</i>).	<i>cicollis</i>).
Baird sandpiper (<i>Pisobia bairdi</i>).	Upland plover (<i>Bartramia longicauda</i>).
	Killdeer (<i>Oryechus vociferus</i>).

The last two eat also other weevils which attack cotton, grapes, and sugar beets. Bill-bugs, which often do considerable damage to corn, seem to be favorite food of some of the shorebirds. They are eaten by the Wilson phalarope, avocet, black-necked stilt, pectoral sandpiper, killdeer, and upland plover. They are an important element of the latter bird's diet, and no fewer than 8 species of them have been found in its food.

Wireworms and their adult forms, click beetles, are devoured by the northern phalarope, woodcock, jacksnipe, pectoral sandpiper, killdeer, and upland plover. The last three feed also on the southern corn leaf-beetle and the last two upon the grapevine colaspis. Other shorebirds that eat leaf-beetles are the Wilson phalarope and dowitcher.

Crayfishes, which are a pest in rice and corn fields in the South and which injure levees, are favorite food of the black-necked stilt, and several other shorebirds feed upon them, notably the jacksnipe, robin snipe, spotted sandpiper, upland plover, and killdeer.

Thus it is evident that shorebirds render important aid by devouring the enemies of farm crops and in other ways, and their services are appreciated by those who have observed the birds in the field. Thus W. A. Clark, of Corpus Christi, Tex., reports that upland plovers are industrious in following the plow and in eating the grubs that destroy garden stuff, corn, and cotton crops. H. W. Tinkham, of Fall River, Mass., says of the spotted sandpiper: "Three pairs nested in a young orchard behind my house and adjacent to my garden. I did not see them once go to the shore for food (shore



FIG. 3.—Upland Plover (*Bartramia longicauda*).

about 1,500 feet away), but I did see them many times make faithful search of my garden for cutworms, spotted squash bugs, and green flies. Cutworms and cabbage worms were their especial prey. After the young could fly, they still kept at work in my garden, and showed no inclination to go to the shore until about August 15. They and a flock of quails just over the wall helped me wonderfully."

In the uncultivated parts of their range also, shorebirds search out and destroy many creatures that are detrimental to man's interest. Several species prey upon the predaceous diving beetles (*Dytiscidæ*), which are a nuisance in fish hatcheries and which destroy many insects, the natural food of fishes. The birds now known to take these beetles are:

Northern phalarope (<i>Lobipes lobatus</i>).	Dowitcher (<i>Macrorhamphus griseus</i>).
Wilson phalarope (<i>Steganopus tricolor</i>).	Robin snipe (<i>Tringa canutus</i>).
Avocet (<i>Recurvirostra americana</i>).	Pectoral sandpiper (<i>Pisobia maculata</i>).
Black-necked stilt (<i>Himantopus mexicanus</i>).	Red-backed sandpiper (<i>Pelidna alpina sakhalina</i>).
Jacksnipe (<i>Gallinago delicata</i>).	Killdeer (<i>Oxyechus vociferus</i>).

Large numbers of marine worms of the genus *Nereis*, which prey upon oysters, are eaten by shorebirds. These worms are common on both the Atlantic and Gulf coasts and are eaten by shorebirds wherever they occur. It is not uncommon to find that from 100 to 250 of them have been eaten at one meal. The birds known to feed upon them are:

Northern phalarope (<i>Lobipes lobatus</i>).	White-rumped sandpiper (<i>Pisobia fuscicollis</i>).
Dowitcher (<i>Macrorhamphus griseus</i>).	
Stilt sandpiper (<i>Micropalama himantopus</i>).	Red-backed sandpiper (<i>Pelidna alpina sakhalina</i>).
Robin snipe (<i>Tringa canutus</i>).	Killdeer (<i>Oxyechus vociferus</i>).
Purple sandpiper (<i>Arquatella maritima</i>).	

The economic record of the shorebirds deserves nothing but praise. These birds injure no crop, but on the contrary feed upon many of the worst enemies of agriculture. It is worth recalling that their diet includes such pests as the Rocky Mountain locust and other injurious grasshoppers, the army worm, cutworms, cabbage worms, cotton worm, cotton cutworm, boll weevil, clover leaf weevil, clover root curculio, rice weevil, corn bill-bugs, wireworms, corn leaf-beetles, cucumber beetles, white grubs, and such foes of stock as the Texas fever tick, horseflies, and mosquitoes. Their warfare on crayfishes must not be overlooked, nor must we forget the more personal debt of gratitude we owe them for preying upon mosquitoes. They are the most important bird enemies of these pests known to us.

SUMMARY.

Shorebirds have been hunted until only a remnant of their once vast numbers is left. Their limited powers of reproduction, coupled with the natural vicissitudes of the breeding period, make their increase slow, and peculiarly expose them to danger of extermination.

In the way of protection a beginning has been made, and a continuous close season until 1915 has been established for the following birds: The killdeer, in Massachusetts and Louisiana; the upland plover, in Massachusetts and Vermont; and the piping plover, in Massachusetts. But, considering the needs and value of these birds, this modicum of protection is small indeed.

The above-named species are not the only ones that should be exempt from persecution, for all the shorebirds of the United States are in great need of better protection. They should be protected, first, to save them from the danger of extermination, and, second, because of their economic importance. So great, indeed, is their economic value, that their retention on the game list and their destruction by sportsmen is a serious loss to agriculture.

Approved:

JAMES WILSON,

Secretary of Agriculture.

WASHINGTON, D. C., *February 9, 1911.*



Issued May 24, 1913.

U. S. DEPARTMENT OF AGRICULTURE
BIOLOGICAL SURVEY — BULLETIN No. 45

HENRY W. HENSHAW, *Chief*

H
DISTRIBUTION AND MIGRATION OF
NORTH AMERICAN HERONS
AND THEIR ALLIES

BY

WELLS W. COOKE

Assistant, Biological Survey



WASHINGTON
GOVERNMENT PRINTING OFFICE

1913

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., February 3, 1913.

SIR: I have the honor to transmit herewith, for publication as Bulletin No. 45 of the Biological Survey, a report on "The Distribution and Migration of North American Herons and Their Allies," by Wells W. Cooke, Assistant in the Biological Survey. Formerly widely distributed in the United States, and very abundant in certain localities, the herons in recent years have everywhere been greatly depleted in numbers, chiefly because of the demand for their plumage for millinery purposes. Several species of egrets bearing the coveted "aigrettes" have, indeed, been almost exterminated, and the few that remain in the United States owe their existence to protective laws and to an aroused public sentiment. This bulletin aims to give precise information as to the range of the several species, especially the breeding range, and in regard to their migration. These data are believed to be amply sufficient to form a basis for protective legislation by the States inhabited by the various species.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction.....	7
Distribution.....	8
Migration.....	9
North American herons and their allies.....	10
Flamingo (<i>Phoenicopterus ruber</i>).....	10
Roseate spoonbill (<i>Ajaia ajaja</i>).....	12
White ibis (<i>Guara alba</i>).....	14
Scarlet ibis (<i>Guara rubra</i>).....	16
Glossy ibis (<i>Plegadis autumnalis</i>).....	17
White-faced glossy ibis (<i>Plegadis guarauna</i>).....	19
Wood ibis (<i>Mycteria americana</i>).....	22
Cayenne ibis (<i>Harpiprion cayennensis</i>).....	24
Jabiru (<i>Jabiru mycteria</i>).....	24
Bittern (<i>Botaurus lentiginosus</i>).....	26
Pinnated heron (<i>Botaurus pinnatus</i>).....	29
Least bittern (<i>Ixobrychus exilis</i>).....	29
Cory least bittern (<i>Ixobrychus noxenus</i>).....	32
Great white heron (<i>Ardea occidentalis</i>).....	33
Great blue heron (<i>Ardea herodias herodias</i>).....	33
Ward heron (<i>Ardea herodias wardi</i>).....	36
Treganza heron (<i>Ardea herodias treganzai</i>).....	36
Northwestern coast heron (<i>Ardea herodias fannini</i>).....	36
California great blue heron (<i>Ardea herodias hyperonca</i>).....	37
West Indian great blue heron (<i>Ardea herodias adoza</i>).....	37
Mexican great blue heron (<i>Ardea herodias lessoni</i>).....	37
Lower California great blue heron (<i>Ardea herodias sanctiluceae</i>).....	38
Galapagos great blue heron (<i>Ardea herodias cognata</i>).....	38
European heron (<i>Ardea cinerea</i>).....	40
Egret (<i>Herodias egretta</i>).....	40
Snowy egret (<i>Egretta candidissima</i>).....	45
Reddish egret (<i>Dichromanassa rufescens</i>).....	49
Louisiana heron (<i>Hydranassa tricolor ruficollis</i>).....	51
Demi-egret (<i>Hydranassa tricolor tricolor</i>).....	52
Little blue heron (<i>Florida caerulea</i>).....	52
Zeledon boatbill (<i>Cochlearius zeledoni</i>).....	55
Pileated heron (<i>Pilherodius pileatus</i>).....	55
Green heron (<i>Butorides virescens virescens</i>).....	56
Anthony green heron (<i>Butorides virescens anthonyi</i>).....	58
Frazar green heron (<i>Butorides virescens frazari</i>).....	59
Green heron (<i>Butorides virescens</i> subsp.).....	59
Lembeye green heron (<i>Butorides brunescens</i>).....	60
Striated heron (<i>Butorides striata</i>).....	60
Black-crowned night heron (<i>Nycticorax nycticorax naevius</i>).....	60
Agami heron (<i>Agamia agami</i>).....	64
Yellow-crowned night heron (<i>Nyctanassa violacea</i>).....	64
Lineated tiger-bittern (<i>Tigrisoma lineatum</i>).....	67
Nicaraguan tiger-bittern (<i>Tigrisoma excellens</i>).....	67
Mexican tiger-bittern (<i>Heterocnus mexicanus</i>).....	67
Index	69

ILLUSTRATIONS.

DISTRIBUTION MAPS.

	Page.
FIG. 1. Flamingo (<i>Phoenicopterus ruber</i>).....	11
2. Roseate spoonbill (<i>Ajaia ajaja</i>).....	13
3. White ibis (<i>Guara alba</i>).....	15
4. Scarlet ibis (<i>Guara rubra</i>).....	16
5. Glossy ibis (<i>Plegadis autumnalis</i>).....	18
6. White-faced glossy ibis (<i>Plegadis guarauna</i>).....	20
7. Wood ibis (<i>Mycteria americana</i>).....	23
8. Jabiru (<i>Jabiru mycteria</i>).....	25
9. Bittern (<i>Botaurus lentiginosus</i>).....	26
10. Least bittern (<i>Ixobrychus exilis</i>).....	30
11. Cory least bittern (<i>Ixobrychus neoxenus</i>).....	33
12. Great white heron (<i>Ardea occidentalis</i>).....	34
13. Great blue heron (<i>Ardea herodias</i>).....	35
14. Egret (<i>Herodias egretta</i>).....	41
15. Snowy egret (<i>Egretta candidissima</i>).....	46
16. Reddish egret (<i>Dichromanassa rufescens</i>).....	50
17. Louisiana heron (<i>Hydranassa tricolor</i>).....	51
18. Little blue heron (<i>Florida caerulea</i>).....	53
19. Green heron (<i>Butorides virescens</i>).....	60
20. Black-crowned night heron (<i>Nycticorax nycticorax naevius</i>).....	61
21. Yellow-crowned night heron (<i>Nyctanassa violacea</i>).....	65

DISTRIBUTION AND MIGRATION OF NORTH AMERICAN HERONS AND THEIR ALLIES.

INTRODUCTION.

The herons have attracted wide attention during late years, particularly because of the earnest efforts that have been made to prevent the utter destruction of the aigrette-bearing members of the family. The horrors necessarily attending the collection of the aigrettes have aroused bird lovers to unprecedented activity. As a result, in some parts of the Union stringent laws have been enacted, and the State machinery for bird preservation has been supplemented by large private subscriptions. Probably no family of birds ever had fuller protection on the statute books than is now enjoyed by the herons, while certainly no birds have ever been the recipients of more zealous care than is now accorded to the remaining colonies of the larger and smaller egrets.

The friends of the birds became aroused none too soon. The large breeding colonies of egrets have been completely destroyed, and only a few scattered remnants exist to serve as centers for reestablishing the species.

Most herons are colony breeding birds, and this fact has been one of the most potent factors in bringing about their destruction. A colony could easily be discovered by watching the lines of flight to and from the feeding grounds, and the succeeding operations were woe-fully simple. The hunter merely waited until the eggs hatched and then, taking his stand within the colony, shot the parent birds as they brought food to the young. No matter how much shooting was done, the old birds—then bearing the nuptial plumes in their greatest perfection—continued to return to their hungry young until the last one was killed. The starving of the young and the utter extinction of the colony were necessary sequels.

So long as these plumes could be sold for their weight in gold and there was an unlimited market for them, neither State laws nor the efforts of zealous game wardens availed much in checking the slaughter. More hopeful conditions are being secured at the present

time by decreasing the market. Already in several of the States it has been made unlawful to sell the aigrettes or even to have them in possession with intent to sell. Could such a law be made general throughout the United States, the killing of aigrette-bearing birds would cease, because the slaughterer would have no market for his plumes. The birds will never be safe until this condition exists.

The larger egret and the snowy egret are the two species that have suffered most severely from the persecutions of the plume hunters, but the millinery trade has also levied a heavy toll on many other members of the group. The flamingo has ceased to breed anywhere in the United States. The roseate spoonbill has become extinct over more than half of its former range in the United States, and its total numbers are probably less than 5 per cent of what they were 50 years ago.

The reduction of numbers in the other herons and in the ibises has not been so pronounced, but several of the species have been driven from the northern two-thirds of their former breeding range and are now restricted to the wildest and most inaccessible parts of the Gulf States.

The food habits of herons and heronlike birds have not been thoroughly investigated. The flamingo is believed to subsist largely on shellfish and crustacea. The spoonbill and the ibises partake of the same fare, but add insects to the bill. The larger wood ibis feeds also on frogs and fishes.

All of the true herons are fond of fish, but in addition they consume many injurious creatures, such as crawfish, water snakes, meadow mice, and other rodents. In the West the great blue heron spends much of its time hunting for pocket gophers. There is no doubt that the herons—especially the black-crowned night heron and the great blue heron—do much damage about fish hatcheries and ponds used as fish preserves, and in such places they should be held in check. But their food habits have redeeming features, and pending conclusions based on careful study of the whole subject, no general aggressive measures against the birds should be permitted.

DISTRIBUTION.

The herons and their allies as a whole are tropical birds, barely extending to the warmer parts of the southern United States. This bulletin treats of 32 species, all that are known to occur in North America south to and including the West Indies and Panama.

One of these, the European heron, is accidental in Greenland; two are stragglers to the southern United States; and several have never been taken within the limits of the United States.

SOUTHERN SPECIES NOT RANGING NORTH TO THE UNITED STATES.

Scarlet ibis (<i>Guara rubra</i>). Accidental five times in the United States.	Striated heron (<i>Butorides striata</i>).
Cayenne ibis (<i>Harpiprion cayennensis</i>).	Agami heron (<i>Agamia agami</i>).
Jabiru (<i>Jabiru mycteria</i>). Accidental once in the United States.	Pileated heron (<i>Pilherodius pileatus</i>).
Zeledon boatbill (<i>Cochlearius zeledoni</i>).	Lineated tiger-bittern (<i>Tigrisoma lineatum</i>).
Pinnated heron (<i>Botaurus pinnatus</i>).	Nicaraguan tiger-bittern (<i>Tigrisoma excellens</i>).
Lembeye green heron (<i>Butorides brunescens</i>).	Mexican tiger-bittern (<i>Heterocnus cabanisi</i>).

SPECIES OCCURRING DURING THE BREEDING SEASON NOT FARTHER NORTH THAN THE SOUTHERN PART OF THE UNITED STATES.

Flamingo (<i>Phoenicopterus ruber</i>). No longer breeds in the United States, but occurs as a rare visitor.	Snowy egret (<i>Egretta candidissima</i>).
Roseate spoonbill (<i>Ajaia ajaja</i>).	Reddish egret (<i>Dichromanassa rufescens</i>).
White ibis (<i>Guara alba</i>).	Louisiana heron (<i>Hydranassa tricolor ruficollis</i>).
Glossy ibis (<i>Plegadis autumnalis</i>).	Little blue heron (<i>Florida caerulea</i>).
Wood ibis (<i>Mycteria americana</i>).	Yellow-crowned night heron (<i>Nyctanassa violacea</i>).
Great white heron (<i>Ardea occidentalis</i>).	
Egret (<i>Herodias egretta</i>).	

SPECIES OF WIDE RANGE IN THE UNITED STATES AND CANADA DURING THE BREEDING SEASON.

White-faced glossy ibis (<i>Plegadis guarauna</i>).	Great blue heron (<i>Ardea herodias</i>).
Bittern (<i>Botaurus lentiginosus</i>).	Green heron (<i>Butorides virescens</i>).
Least bittern (<i>Ixobrychus exilis</i>).	Black-crowned night heron (<i>Nycticorax nycticorax naevius</i>).
Cory least bittern (<i>Ixobrychus neoxenus</i>).	

SUMMARY.

Species of wide range in the United States.....	7
Species ranging north to the southern United States.....	12
Species not ranging north to the United States.....	10
Tropical species occurring as stragglers in the United States.....	2
Species occurring as a straggler from Europe.....	1
Total.....	32

MIGRATION.

The herons that breed south of the United States are for the most part nonmigratory. The same is true of the herons breeding in the tropical parts of Florida and Texas. All herons breeding farther north are at least partially migratory, for although a few individuals may remain through the winter in the vicinity of the nesting site,

yet the great majority retire at this season to more genial climes. Those breeding north of the Gulf States are almost completely migratory, though occasionally a bittern, a great blue heron, or a black-crowned night heron elects to spend the winter where large swamps or warm springs offer a precarious livelihood far north of the freezing line.

The most striking peculiarity of the migrations of the herons is their northward movement in the fall. Though not universal, yet it is a common habit for the young herons to wander in the late summer and early fall long distances, even several hundred miles, north of the district where they were hatched. They remain from a week to a month at their picnic grounds and finally depart for their winter home.

A still more remarkable migration habit is that of the snowy egret. Numbers of these birds migrate in the spring far north of the breeding range and remain throughout the summer in these northern districts as nonbreeders. The birds are, of course, adults, and sometimes they are found during the summer 500 to 1,000 miles north of the nearest known breeding grounds of the species. This habit of the snowy egret seems not to be shared by any other North American species.

The data in this bulletin on the distribution and breeding of the several species have been obtained largely from the printed records in ornithological literature. The extended migration tables are made possible by the reports of many hundred observers who have filled out migration schedules for the Biological Survey. Occasion is taken herewith to extend to these observers well-merited thanks for their painstaking care and for the large amount of time they have devoted to the study of bird movements.

NORTH AMERICAN HERONS AND THEIR ALLIES.

Flamingo. *Phoenicopterus ruber* Linnæus.

Range.—Florida, Yucatan, and the Bahamas, and southeast through the West Indies to Venezuela, the mouth of the Amazon, and the Galapagos; accidental in South Carolina and Louisiana.

Breeding range.—The flamingo is not a migrant in the ordinary sense of the word, and its occurrence outside of the breeding range is due to its wandering into contiguous regions in search of food. The species nested formerly among the keys of southern Florida in the vicinity of Indian Key (Audubon), and Cape Sable (Scott), but was driven away many years ago, and there seems to be no certain record of breeding in Florida during the past 20 years.

The principal breeding range seems to have been the Bahamas, which furnished in abundance the peculiar natural conditions re-

quired for the nesting site. Nests have been known throughout the Bahamas from Great Abaco (Allen), on the north to Great Inagua (Bryant), on the south, and as late as 1905 the birds were still nesting in considerable numbers on Andros Island (Riley). Large breeding colonies have existed in the vicinity of Cienfuegos, Cuba, and this port has been for many years one of the principal places of shipment for live flamingos. The flamingo is also known to have nested on the Isle of Pines (Gundlach); Rio Lagartos, Yucatan (Boucard); Bonaire Island, off the coast of Venezuela (Hartert); near the mouth of Waini Creek on the coast of British Guiana (Lloyd); on the coast of French Guiana near Cayenne (Waterton); and south to

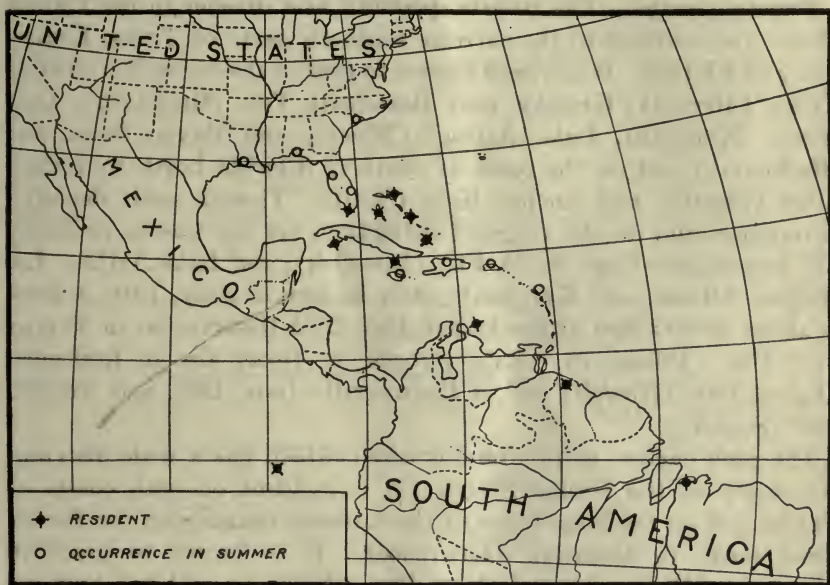


FIG. 1.—Flamingo (*Phoenicopterus ruber*).

the vicinity of the mouth of the Amazon River at Praia de Cajutuba, Brazil (Pelzeln), and to the Galapagos Islands (Beck).

Eggs have been found in the Bahamas, May 14, 1884 (Maynard); June 7, 1886 (Blake); and May 8, 1904 (Chapman); young out of the nest in the Bahamas, May 28, 1898 (Chapman); young on the Galapagos, April 1, 1902 (Beck).

Migration range.—Outside of the breeding season the flamingo used to be not uncommon on the west coast of Florida north to Tampa Bay (Scott), and a few probably still visit Florida, for they were noted at Upper Matecumbe Key, March 7, 1906 (Brodhead), and Lake Worth, May, 1905 (Ryman), but none probably winter anywhere in Florida. The flamingo has been noted also at Warrington, Fla. (Stone); Charleston, S. C. (Audubon); Georgetown, S. C., September, 1876 (Loomis); and at Cameron, La., December 6, 1910

(McAtee). One visited Bermuda September 24, 1849 (Hurdiss), and the species has been recorded as a visitor to Jamaica (March), Haiti (Ritter), Porto Rico (Gundlach), Guadeloupe, Antigua, Anegada (Clark), Colombia (Masquera), and the Orinoco River in Venezuela (Burger).

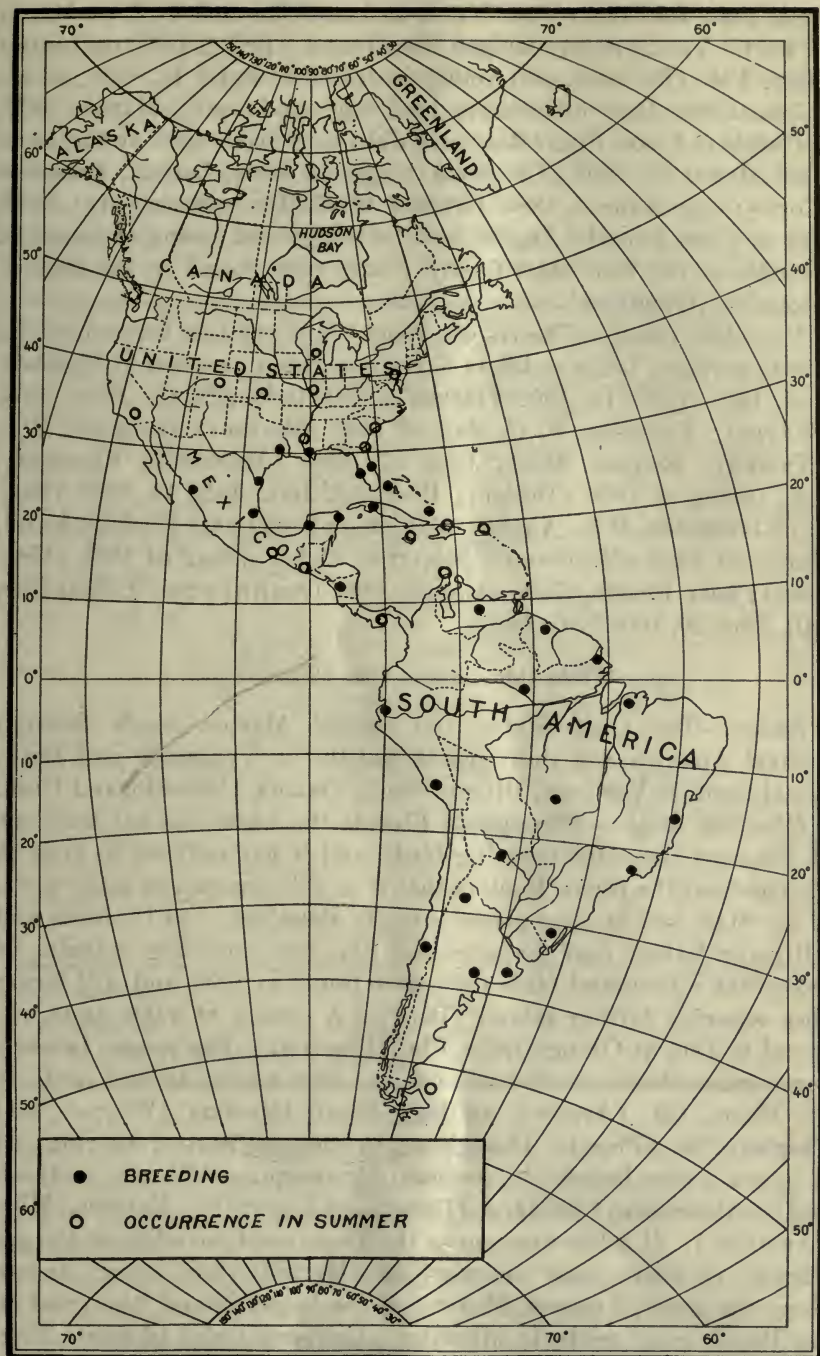
Roseate Spoonbill. *Ajaia ajaja* (Linnæus).

Range.—Florida, Louisiana, Texas, and central Mexico, south to southern Patagonia; formerly north casually to South Carolina and Indiana; accidental in Pennsylvania, Wisconsin, Kansas, Colorado, and California.

Breeding range.—The roseate spoonbill as a breeder in the United States was confined to the extreme southern parts of Texas, Louisiana, and Florida. It has been known to nest in the lower Rio Grande Valley (Merrill); Grigsby, near Beaumont, Tex. (Rachford); Calcasieu (Kopman), Lake Arthur (Beyer), and Bayou Sara, La. (Beckham); and on the coast of southern Florida north to Indian River (Bryant) and Anclote Keys (Scott). Though sadly depleted in numbers and on the verge of extinction, yet the species probably still breeds near Cape Sable, Fla. (Bowditch), and Lake Arthur, La. (Beyer, Allison, and Kopman), while as late as July, 1910, a flock of about 50 was seen at the Indian Key Bird Reservation in Tampa Bay, Fla. (Pillsbury). Late records in Texas are at Rockport, August, 1905 (Howell) and at Brownsville June, 1907, and August, 1909 (Smith).

The pink curlew, as this bird is often called, has a wide distribution south of the United States. It is resident on both coasts of Mexico and on the large lakes of the interior, ranging on the Pacific Coast north to Mazatlan (Lawrence). It is known to breed in Nicaragua (Ridgway) and Costa Rica (Nutting) and has been recorded as occurring in Guatemala (Goss), Panama (Sharpe), and Colombia (Robinson). It used to be a common breeder in Great Inagua Island, Bahamas (Cory), in Cuba (Gundlach), and on the Isle of Pines (Poey), but is now rare if not extinct throughout this region. It has been recorded as a rare visitant to Jamaica (March), Haiti (Tristram), Porto Rico (Bowditch), and several of the Lesser Antilles including Trinidad Island (Leotaud), while from the coast of Venezuela (Ernst) south to Bahia Blanca, Argentina (Barrows) and to Santiago, Chile (Philippi), it is not rare either on the coast or in the interior on the larger rivers. A few have wandered south to the Falkland Islands (Abbott) and the Strait of Magellan (Sclater and Hudson).

The breeding season is evidently exceedingly variable and greatly extended. The National Museum contains eggs taken near Key

FIG. 2.—Roseate spoonbill (*Ajaia ajaja*).

West, Fla., January 16, 1886, and at Lake Okeechobee, Fla., March 14, 1874. Young nearly fledged were found April 1, 1858, on Indian River, Fla. (Bryant), and young in the nest April 19, 1882, at La Palma, Costa Rica (Nutting); both eggs and young May 1, 1903, at Cuthbert Lake, Fla. (Bent and Job) and fresh eggs at the same place March 29, 1908 (Chapman); eggs in June, Inagua, Bahamas (Cory); eggs June 2, 1886, Grigsby Bluff, Tex. (Rachford); fresh eggs in Cuba in early August, and both eggs and young at intervals throughout the fall, until finally young were found in the nest in December (Gundlach).

Migration range.—The roseate spoonbill is resident throughout its breeding range, but wanderers have been taken or noted at Cumberland, Ga., April 13, 1902 (Helme); Charleston, S. C., June, 1879 (Wayne); Yemassee, S. C., fall of 1885 (Wayne); Lancaster, Pa., (Warren); Rodney, Miss., June 27, 1889 (Mabbett); Vincennes, Ind., spring of 1856 (Butler); Portland, Ind., July 14, 1889 (Butler); Janesville, Wis., August, 1845 (Kumlein); near Wichita, Kans., March 20, 1899 (Matthews); Silverton, Colo., spring of 1888 (Morrison); near Pueblo, Colo., August, 1890 (Smith); San Bernardino, Cal., June 20, 1903 (Stephens).

White Ibis. *Guara alba* (Linnæus).

Range.—The Gulf States and central Mexico, south through Central America and the Greater Antilles to Venezuela and Peru; casual north to Vermont, Illinois, South Dakota, Colorado, and Utah.

Breeding range.—Throughout Florida the white ibis has been one of the most abundant breeding birds, and it has suffered so little at the hands of the plume hunters that it is still common in many parts of the State and in some places is really abundant. At Cuthbert and Alligator Lakes, near Cape Sable, Fla., two breeding colonies of more than a thousand birds each were found in 1903, and still larger ones reported farther inland (Bent). A colony of 4,000 nests was found in 1911 at Orange Lake, Fla. (Pearson). The species becomes less common to the northward, but has been known to nest north to St. Marys, Ga. (Arnow), southern South Carolina (Wayne), and Chipley, Fla. (Pleas). Though not so common west of Florida, yet it is not a rare breeder in southern Mississippi (Allison), southern and southwestern Louisiana (Beyer), and north to Natchez, Miss. (Audubon). It is less common on the Texas coast, breeding at Corpus Christi (Sennett) and Brownsville (Merrill), and occurs thence along the coast of eastern Mexico, on the larger inland lakes, and on the Pacific coast north to Mazatlan (Lawrence) and to Santa Margarita Island (Anthony). Though formerly abundant and still common in Cuba (Gundlach) and Isle of Pines (Bangs and Zappey), it seems not to have been common in the rest of its range in the West

Indies, though recorded from Jamaica (Field), Haiti (Christi), and Dominica (Clark). It occurs locally and not rarely along the whole Pacific coast of Central America south to the Rio Sabana, Panama (Salvadori and Festa), and has been recorded at the following places in northern South America: Zulia and Lake Valencia, Venezuela (Ernst); Vaqueria, northwestern Ecuador (Hartert); and Santa Luzia, northwestern Peru (Taczanowski).

Eggs have been taken March 28, 1898, at Lake Okechobee, Fla. (specimens in Thayer collection); April 24, 1888, at Tarpon Springs,

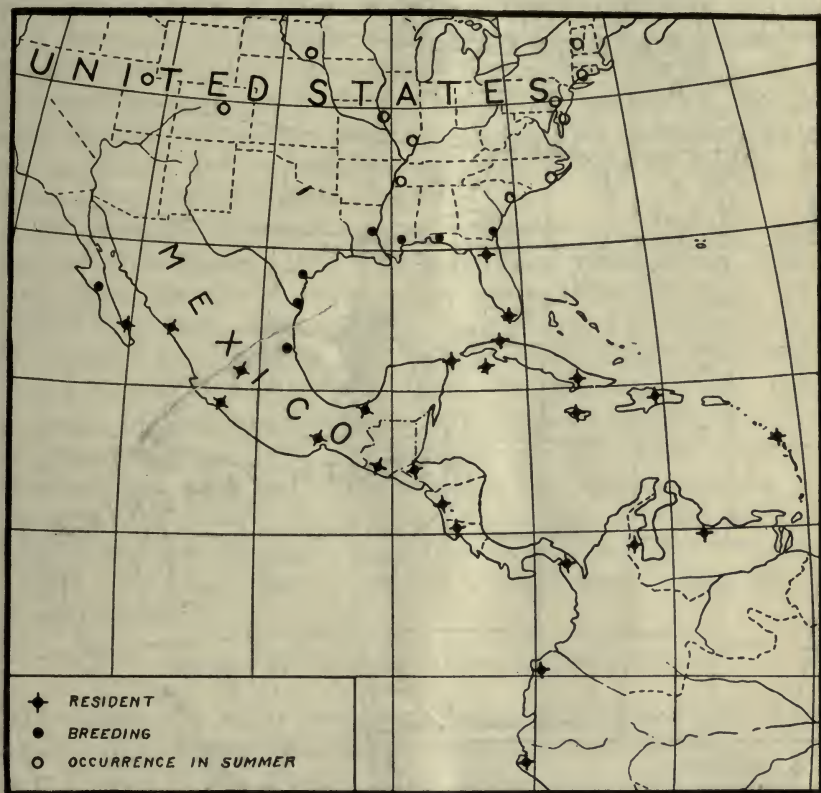


FIG. 3.—White ibis (*Guara alba*).

Fla. (Scott); fresh eggs, May 1, 1903, at Cuthbert Lake, Fla.; and young able to fly, May 15, 1903, at Alligator Lake, only a few miles distant (Bent). In Cuba these birds are said to nest from April to September.

Winter range.—The white ibis is resident throughout its range in Central and South America and the West Indies. It winters in the United States north to Gainesville, Fla. (Chapman), and to southern Louisiana (Beyer, Allison, and Kopman), and in western Mexico north to La Barca (Goldman), Mazatlan (Lawrence), and to La Paz (Belding).

Spring migration.—A slight northward migration occurs in spring, bringing the birds to Whitfield, Fla., March 17, 1903 (Worthington); Pensacola, Fla., March 19, 1886 (Evermann); St. Marys, Ga., March 17, 1904 (Arnow). Beyond this they have been taken as wanderers at Beaufort, N. C., July 26, 1908 (Pearson); Philadelphia, Pa. (Warren); Great Egg Harbor, N. J., 1858 (Turnbull); Moriches and Raynor South, N. Y. (Giraud); Milford, Conn., May 23, 1875 (Merriam); South Woodstock, Vt., summer of 1878 (Tracy);

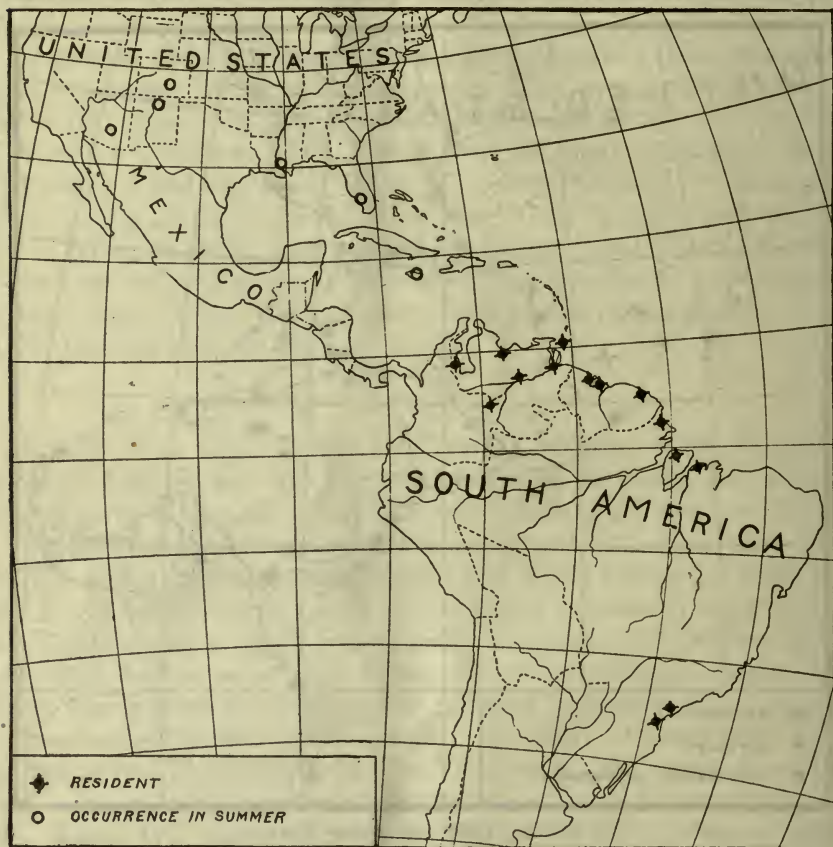


FIG. 4.—Scarlet ibis (*Guara rubra*).

Memphis, Tenn. (Audubon); Quincy, Ill. (Widmann); Mt. Carmel, Ill., May 8, 1878 (Ridgway); Vermilion, S. Dak., May, 1879 (Agersborg); Barr Lake, Colo., 1890 (Smith); Ogden, Utah, September, 1871 (Allen).

Scarlet Ibis. *Guara rubra* (Linnæus).

The range of the scarlet ibis is northern South America from eastern Colombia to the mouth of the Amazon; north casually to the United States.

The principal home of this bird is the northern coast of South America from Zulua, Venezuela (Ernst), and Trinidad Island (Leotaud) to the mouth of the Amazon (Allen). It penetrates the interior of Colombia to the Meta River (Burger), follows the Amazon up to the Rio Negro (Ihering), and goes south on the coast of Brazil to Iguape, Sao Paulo (Ihering). When Waterton visited South America in 1812, he found scarlet ibises in innumerable flocks along the coast of British Guiana near Georgetown and four years later found them equally abundant on the coast of French Guiana, both east and west of Cayenne. The brilliant coloring of the bird early drew to it the attention of the plumage hunter, and about 1895 its skins formed a not inconsiderable part of the \$200,000 worth of plumage exported yearly from Para, Brazil (Goeldi). Though sadly depleted in numbers, yet it is still far from extinction, for as late as March, 1909, several hundred were in sight at once on the Waini River, British Guiana (Beebe).

The scarlet ibis is only a very rare straggler in the United States and the West Indies. The records north of South America are: Costa Rica (Zeledon); Jamaica previous to 1847 (Denny); Fort Ogden, Fla., May, 1888 (Scott); Bayou Sara, La., July 3, 1821 (Audubon); Los Pinos, N. Mex. (Coues); Fort Lowell, Ariz., September 17, 1890 (Brown); Grape Creek, Wet Mountain Valley, Colo. (Lowe). Linnæus based his name of this species on Catesby's plate and description of birds that were said to have come from the Bahamas, but since the scarlet ibis has no other record for the Bahamas, it is probable that Catesby was misled as to the origin of his birds and that they really came from South America.

Eggs were taken May 2, 1901, in Dutch Guiana (specimens in Thayer collection).

Glossy Ibis. *Plegadis autumnalis* (Linnæus).

The glossy ibis has a wide range in the tropical and subtropical regions of the Eastern Hemisphere, extending north to Spain, Hungary, Greece, Persia, Turkestan, and China, and south to southern Africa, Borneo, and Australia. A very small percentage of the species occurs in the Western Hemisphere, where it is found principally in Jamaica, Cuba, Florida, and Louisiana; casual north to Nova Scotia, Ontario, Wisconsin, Nebraska, and Colorado.

The status of this species in Florida is not well defined. Both this and the white-faced glossy ibis occur in Florida, breeding in close proximity, and they agree so closely in appearance that they can not be distinguished by sight at ordinary distances. Hence it is possible that some of the following records of the glossy ibis refer really to the white-faced species. The former is recorded from

Fort Myers, spring of 1886 (Scott); Caloosahatchee River, April 20, 1881 (specimen in U. S. National Museum); Orlando, nested 1909 (Hyer); Gainesville, nested 1910 (Baynard); Micanopy, nested (Baird, Brewer, and Ridgway); Tortugas, 1860 (specimen in U. S.



FIG. 5.—Glossy ibis (*Plegadis autumnalis*).

National Museum); Upper St. Johns, summer 1903 (Bent); near Cape Sable, summer 1903 (Bent); Orange Lake, Fla., eggs May 4-12, 1911 (Philipp).

The Louisiana records also are in an unsatisfactory condition. Apparently both species of glossy ibis occur at Lake Arthur and

both breed there, but their relative distribution in the rest of the State remains to be determined.

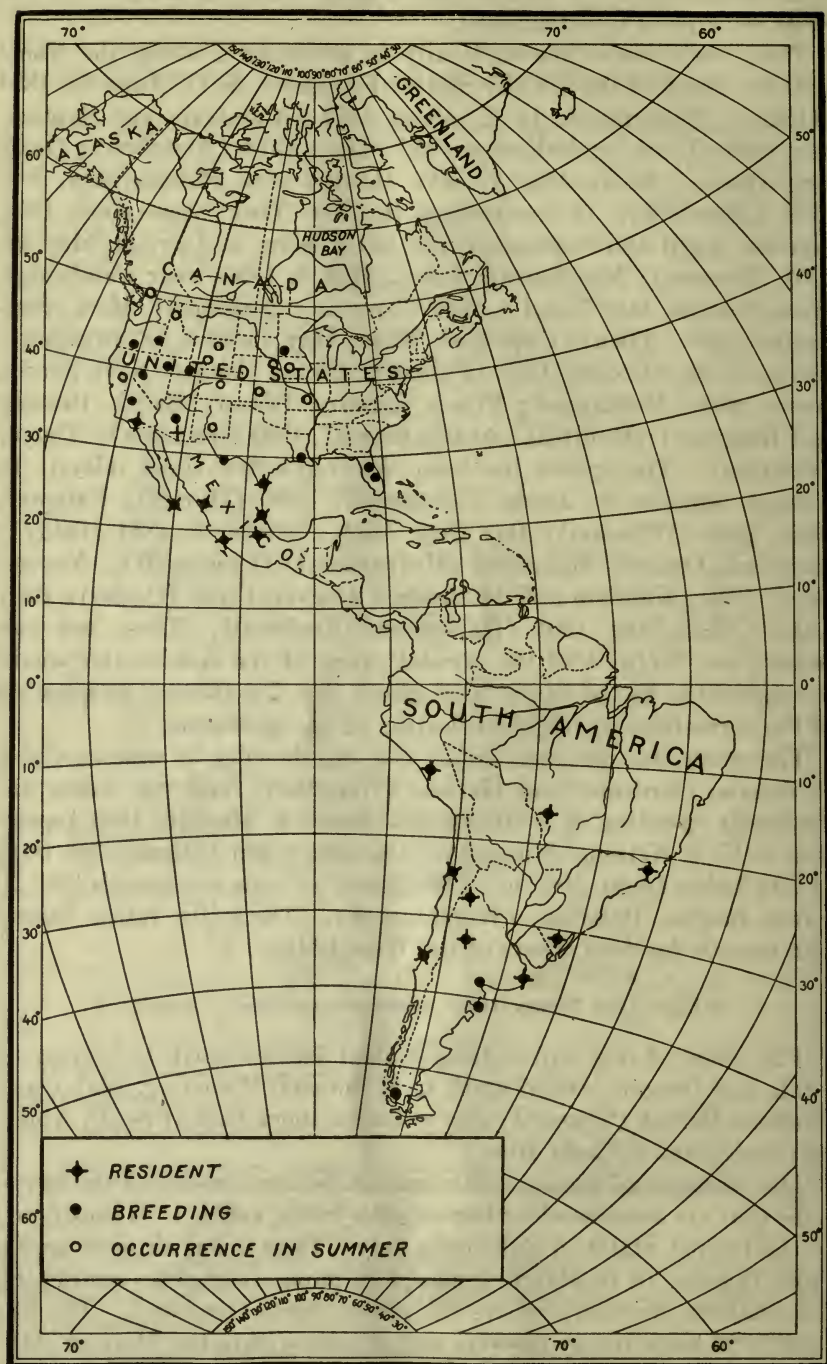
The glossy ibis is known locally as a wanderer along the whole Atlantic coast of the United States: Frogmore, S. C., June 30, 1884 (Hoxie); Washington, D. C., about 1817 (Audubon) and September, 1900 (Daniel); Baltimore, Md., May, 1817 (Audubon); Great Egg Harbor, N. J., May 7, 1817 (Ord); near Philadelphia, Pa., 1866 (Turnbull); 10 occurrences in New York State since 1844, between April and September, the latest being at Cayuga, May 21, 1907 (Fuertes); Middletown, Conn., May 9, 1850; near Cambridge, Mass., 5 birds, May 7 and 8, 1850 (Browne); Nantucket, Mass., September, 1869 (Allen); Cape Cod, Mass., May 4 and 5, 1878 (Allen); Alton, N. H., October, 1858 (Palmer); Pictou County, Nova Scotia, about 1865 (McKinlay); Prince Edward Island (Baird, Brewer, and Ridgway); Montreal, Canada, May 27, 1900 (specimen in Thayer collection). The species has been observed a few times inland: In Illinois, opposite St. Louis, February 27, 1880 (Hurter); Fairport, Ohio, 1848 (Wheaton); Bay City, Mich., October 6, 1884 (Eddy); Hamilton, Ontario, May, 1857 (McIlwraith); Horicon, Wis., November 3, 1879 (Kumlein and Hollister); Denver, Colo. (Cooke); Barr Lake, Colo., June, 1905 (Hersey and Rockwell). These last two records are far west of the normal range of the species and would be expected to be the white-faced glossy ibis, but there is no question of the correctness of the identification of the specimens.

The glossy ibis has been found as a rare breeder in western Cuba, at Zapata, Cardenas, and Habana (Gundlach), and was taken undoubtedly breeding at Spanishtown, Jamaica, May 16, 1865 (specimen in U. S. National Museum). One was taken February 22, 1900, at Cay Lobos Light, Bahamas (Bonhote), and one was seen in 1909 on Great Inagua, Bahamas (Worthington). There are rather uncertain records for four others of the West Indies.

White-faced Glossy Ibis. *Plegadis guarauna* (Linnæus).

The range of this bird is from central Mexico north to Louisiana, Utah, and Oregon; casual north to Minnesota, Wyoming, Idaho, and southern British Columbia; also in the southern half of South America; accidental in Costa Rica.

The white-faced glossy ibis is one of the few species of the heron tribe that are considered by law as game birds, and it is so considered in the United States in California only. Here it has an open season from October 15 to March 1, except in game district 6 (comprising the southern counties), where the season opens October 1. The bag limit is 20 birds in any one day and all sale within the State or shipment without the State is prohibited. The species is most common

FIG. 6.—White-faced glossy ibis (*Plegadis guarauna*).

in the southern and central parts of the State, especially in the San Joaquin Valley.

In all but three of the other States where the white-faced glossy ibis occurs it is protected by law for the most part under the provisions of the general law that protects all but certain specified game birds. In Nevada, Kansas, and New Mexico, however, the species is not protected by law at any time in the year.

The habitat of the white-faced glossy ibis presents one of the best examples of a discontinuous range. The bird is apparently absent from the whole of Central America and from northern South America and the valley of the Amazon River. To the northward it ranges from latitude 18° to 44° , while south of the equator the range extends from 12° to 55° .

The white-faced glossy ibis breeds from the Valley of Toluca (Goldman), Manzanillo Bay (Lawrence), and San Jose del Cabo (Belding), Mexico; north to Great Salt Lake, Utah (Goodwin), and Malheur Lake, Oreg. (Finley). It also breeds along the coast of Texas, at Lake Arthur, La. (specimen in U. S. National Museum), and at Lake Washington, Fla. (Brewster). The species probably ranges regularly east to southwestern Louisiana, but, as already remarked under the last species, how common or regular it is in Florida remains yet to be determined. The species has wandered north to Rippey, Iowa, April, 1891 (Nutting); Spirit Lake, Iowa, May 15 to 21, 1890 (Mosher); Heron Lake, Minn., nested in 1894 and 1895 (Peabody); near Omaha, Nebr., August 19, 1893, and April 6, 1897 (Bruner, Wolcott, and Swenk); Red Bank, Wyo., 1893 (Knight); Lake Pend Oreille, Idaho, 1909 (Moody); Salt Spring Island and the mouth of the Fraser River in southwestern British Columbia (Fannin).

The white-faced glossy ibis winters throughout its range in Mexico and north to Brownsville, Tex. (Merrill); Gum Cove, La. (McAtee); Tombstone, Ariz. (Willard); and Los Angeles County, Cal. (Grinnell).

The breeding range in South America extends from near Callao, Peru (Cassin); and Rio Janeiro, Brazil (Sharpe); south to the Strait of Magellan (Dabbene); and the species is common on the larger rivers of the interior north to Ypanema, Brazil, on the Paraguay River at 16° south latitude (Pelzeln). It retires in the winter from the southern part of this breeding range, but remains at this season as far south as Cape San Antonio, Argentine (Gibson); and Santiago, Chile (specimen in U. S. National Museum).

The regular ranges in North America and South America are separated by 30° of latitude and 22° of longitude. There is only one record for the species in the whole 3,000 miles—a single bird, taken on the Diquis River in southwestern Cost Rica (Cherrie), which

had wandered about 1,200 miles from the nearest part of the bird's regular home.

Eggs are most commonly found in Argentina during November (Holland) and in Chile during November and December (Germain). North of the equator eggs have been taken at Lake Washington, Fla., April 18, 1886 (Brewster); Heron Lake, Minn., June 26, 1894, June 22 and July 2, 1895 (Peabody); Brownsville, Tex., May 16, 1877 (Merrill); Waco, Tex., April 22, 1900 (specimens in Thayer collection); San Diego, Cal., May 29, 1893 (Shields); Quinn River, Nev., May 11, 1881 (specimens in U. S. National Museum).

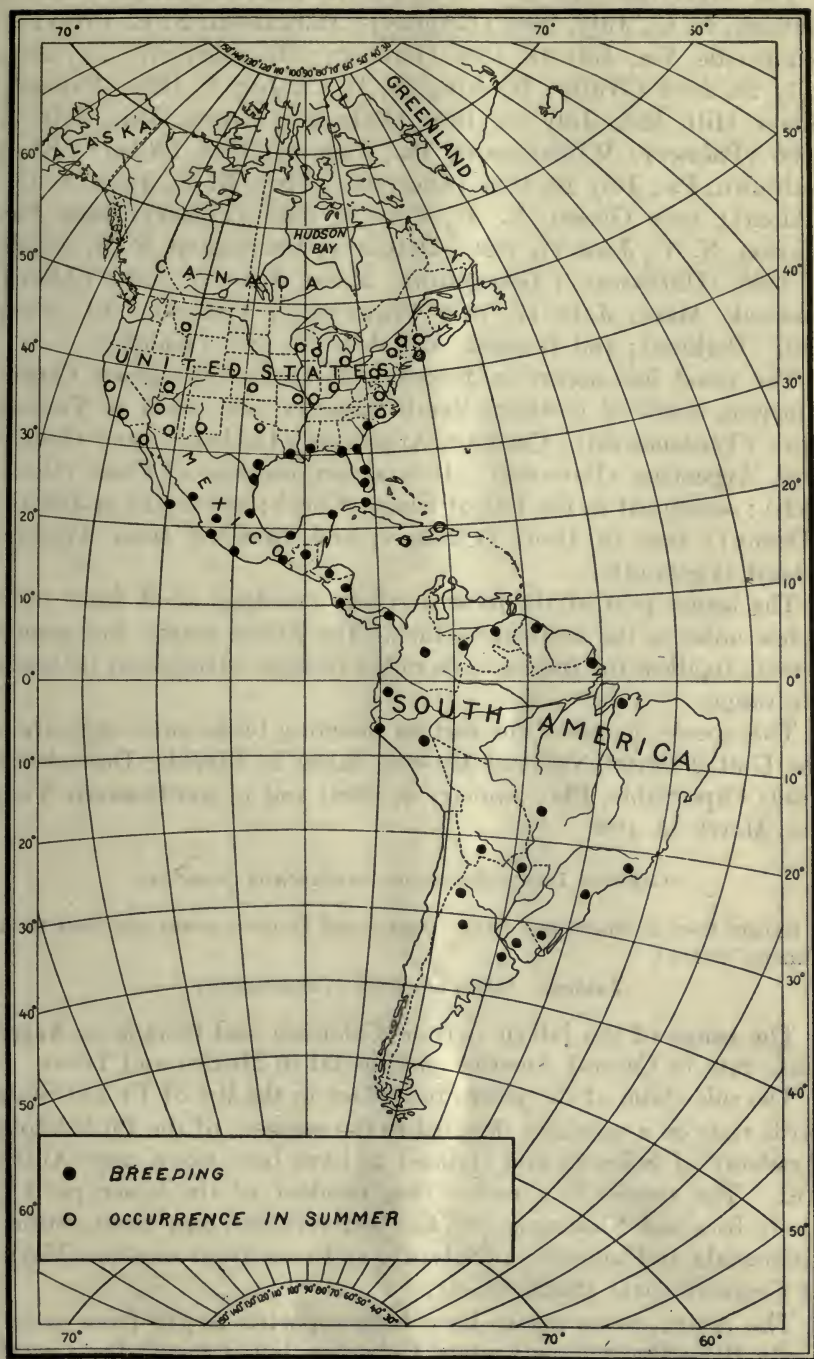
Wood Ibis. *Mycteria americana* Linnæus.

The range of the wood ibis is from the Gulf States and central Mexico south through Cuba and Central America to Argentina; casual north to New England, Ohio, Wisconsin, Montana, and California.

This bird is a tropical species of wide distribution in Central and South America. It is common in the United States only in Florida and along the Gulf coast to southern Texas. It breeds less commonly north to Colleton County, S. C. (Wayne); and to Rodney, Miss. (Mabbett); while in Mexico the breeding range extends north to Mazatlan and La Paz.

After the breeding season and when the young are fully grown both old and young are in the habit of moving northward to the swamps along the Mississippi River, particularly in southeastern Missouri and southern Illinois, which at this season of the year are swarming with their favorite food. Here they are common from July to September, while occasional flocks or individuals wander still farther and have been recorded at New Haven, Mo., August 11 to September 11, 1902 (Eimbeck); Brookville, Ind., August, 1855 (Evermann); Lyons, Ind., June 27, 1910, and June to September, 1911 (Van Gorder); Cleveland, Ohio (Jones); near Monroe, Mich., June 19, 1910 (Taverner); Racine, Wis., September, 1868 (Hoy); La Crosse, Wis., 1852 (Kumlein and Hollister); Ellis, Kans., March 26, 1885 (Goss); Waldron, Kans., June 29, 1908 (Matthews); Fort Thorn, N. Mex. (Henry); near Denver, Colo., August 30, 1902 (Felger); Ennis, Mont., October, 1902 (Cooley); Idaho City, Idaho, June 25, 1910 (Jewett).

The breeding birds of the coast of western Mexico also work northward in the fall, are especially common in the valley of the lower Colorado River, and are irregular visitants to southern California. They have been taken thence north to Fort Mohave, Ariz. (Coues); Rush Lake, Utah, October 1, 1872 (Yarrow and Henshaw); Nevada, July, 1871 (specimen in U. S. National Museum); and Hayward, Cal. (Grinnell).

FIG. 7.—Wood Ibis (*Mycteria americana*).

The wood ibis has been noted in the eastern United States at Raleigh, N. C., July, 1884 (Brimley); Morganton, N. C. (Wayne); Vinitaville, Va., July 18, 1896 (Palmer); Bloomery, W. Va., about July 28, 1884 (Wall); Washington, D. C., July 2, 1892 (Palmer); Silver Hill, Md., July 20, 1896 (Palmer); Laurel, Md., July 27, 1896 (Palmer); Williamsport, Pa., June 21, 1876 (Allen); Elizabethtown, Pa., July 10, 1884 (Sherratt); Troy, N. Y., June 24, 1876 (Allen); near Glasco, N. Y., July 8, 1884 (Fisher); near East Marion, N. Y., June 21, 1890 (Dutcher); Barrington, R. I., August 8, 1896 (Hathaway); Georgetown, Mass., June 19, 1880 (Allen); Seekonk, Mass., July 17, 1896 (Brewster); Williston, Vt., about 1897 (Perkins); and Berwick, Me., July 16, 1896 (Knight).

The wood ibis occurs in favorable localities throughout Central America, much of northern South America, and south to Tumbez, Peru (Taczanowski); Cordoba, Argentina (Dabbene); and Concepcion, Argentina (Barrows). It is a rare resident of Cuba (Gundlach); occasional in the Isle of Pines (Cory); accidental in Jamaica (Denny); rare in Haiti (Christi); and recorded from Trinidad Island. (Leotaud).

The larger part of the most northern breeding wood ibises retire a few miles to the southward during the winter season, but enough remain to allow the species to be called resident throughout its breeding range.

This species is one of the earliest breeding birds, since eggs are in the United States National Museum taken in Florida, December 8, 1859; Cape Sable, Fla., January 5, 1892; and in southeastern Yucatan, March 15, 1890.

[Cayenne Ibis. *Harpiprion cayennensis* (Gmelin).]

Ranges from southern Sao Paulo, Brazil, and Ecuador north and west to the Panama Canal.]

Jabiru. *Jabiru mycteria* (Lichtenstein).

The range of the jabiru is from Colombia and Guiana to Argentina; rare in Central America; accidental in Mexico and Texas.

The sole claim of the jabiru to a place in the list of United States birds rests on a specimen donated to the museum of the Philadelphia Academy of Sciences and claimed to have been taken near Austin, Tex. The species is a rather rare resident of the lower parts of Costa Rica and Nicaragua, and has been recorded once from southern Guatemala at Haumuchal (Salvin); and once from southern Mexico at Cosamaloapam (Sumichrast).

The jabiru seems not to have been reported as yet from eastern Costa Rica, Panama, or western Colombia, but it occurs from north-eastern Colombia (Robinson); Venezuela (Ernst); Tobago Island (Jardine); and British Guiana (Cabanis); south throughout Brazil

FIG. 8.—Jabiru (*Jabiru mycterta*).

and Paraguay to Cordoba, Argentina (Dabbene); and to Buenos Aires, Argentina (Hudson). It also ranges west to central Peru (Taczanowski). Eggs were taken October 10, 1904, on the Chaco of Argentina (Hartert and Venturi).



FIG. 9.—Bittern (*Botaurus lentiginosus*).

Bittern. *Botaurus lentiginosus* (Montagu).

Range.—Nearly the whole of North America, from Panama and the Greater Antilles north to British Columbia, Mackenzie, and Newfoundland.

Breeding range.—The bittern is one of the most northern breeders of its family. During the summer it ranges north to

the southern part of the Cariboo District, B. C. (Brooks); Peace River Landing, Alberta (Macoun); Fort Norman, Mackenzie (Preble); Prince Albert, Saskatchewan (Ferry); Fort Churchill, Keewatin (Clarke); Fort George, on the east side of James Bay (Selwyn); Godbout, Quebec (Comeau); Anticosti Island, Quebec (Verrill); Humber River, Newfoundland (Porter); and St. John, Newfoundland (Howley). It was once seen at Cape St. Francis near the Strait of Belle Isle (Bigelow). The southern boundary of the normal breeding range extends from Buena Vista Lake, Cal. (Goldman); Pahrnagat Valley, Nev. (Merriam), and Utah Lake, Utah (Johnson), east to Barr Lake, Colo. (Felger), Wichita, Kans. (Matthews), Henderson, Ky. (Alves); Variety Mills, Va. (Micklem), and Cape May, N. J. (Hand). South of this normal summer range, the species has been found breeding at Lerma, Mexico (Goldman); Alamitos, Los Angeles County, Cal. (Robertson); Mormon Lake, Ariz. (Mearns); Raleigh, N. C. (Brimley); and Yemassee, S. C. (Wayne).

Winter range.—The principal winter home is in the southern United States, from which a few pass south throughout Mexico and as far south as Coban, Guatemala (Salvin); Reventazon, Costa Rica (Bangs); Cariblanco and Turrucare, Costa Rica (Lankester); Laguna de Ochomogo, Costa Rica (Carriker); and Isthmus of Panama (Lawrence). The species is not rare in western Cuba (Gundlach), the Isle of Pines (Gundlach), and the northern Bahamas (Bonhote). It winters north to Marysville, Cal. (Belding), the lower Ohio Valley, and North Carolina; and is rare or casual at Canton, Ill. (Cobleigh), and Washington, D. C. (Coues). One was seen December 28, 1904, at a warm spring near Fort Morgan, Colo. (Felger), far north of the usual winter home.

Migration range.—Specimens have been taken in Jamaica (Denny) and Porto Rico (Gundlach), though the species is not known to occur regularly in either of these islands. Many individuals have found their way, spring and fall, to Bermuda (Jardine), though their appearance there is so irregular as to suggest accident rather than design. A straggler to Piddletown, England, became the basis of the original description of the species.

Spring migration.

Place.	Number of years' records.	Average date of spring arrival.	Earliest date of spring arrival.
Raleigh, N. C.....	9	Apr. 1	Mar. 19, 1908
Pea Island, N. C.....			Feb. 11, 1901
Andrews, N. C.....	2	Apr. 22	Apr. 18, 1902
Weaverville, N. C.....			Apr. 12, 1891
Washington, D. C.....	3	Apr. 7	Mar. 22, 1894
Baltimore, Md.....			Mar. 31, 1898
Erie, Pa.....	5	Apr. 12	Apr. 4, 1888
Renovo, Pa.....	6	Apr. 10	Mar. 29, 1907

Spring migration—Continued.

Place.	Number of years' records.	Average date of spring arrival.	Earliest date of spring arrival.
Northern New Jersey.....	3	Apr. 11	Mar. 27, 1909
Ithaca, N. Y.....			Mar. 28, 1908
Canandaigua, N. Y. (near).....	12	Apr. 22	Apr. 14, 1905
Jewett City, Conn. (near).....	7	Apr. 21	Apr. 17, 1906
Beverly, Mass.....	9	Apr. 20	Apr. 15, 1909
West Groton, Mass.....	7	Apr. 22	Apr. 17, 1898
Monadnock, N. H.....	2	Apr. 16	Apr. 14, 1905
Phillips, Me.....	5	Apr. 25	Apr. 11, 1905
Pittsfield, Me.....	3	May 8	May 4, 1895
Fort Kent, Me.....			May 4, 1905
Montreal, Canada.....	5	Apr. 25	Apr. 20, 1908
Quebec, Canada.....	2	Apr. 27	Apr. 25, 1906
Pictou, N. S.....	9	Apr. 22	Apr. 15, 1892
Halifax, N. S.....	3	May 7	May 5, 1902
Blackville, N. B. (near).....	3	May 11	May 7, 1906
North River, P. E. I.....			May 20, 1888
Godbout, Quebec.....			May 12, 1895
Fayetteville, Ark.....			Mar. 31, 1883
Monteer, Mo.....			Mar. 26, 1904
Odin, Ill.....	2	Apr. 5	Apr. 1, 1892
Canton, Ill.....			Jan. 15, 1894
Vincennes, Ind.....	2	Apr. 4	Apr. 3, 1888
Oberlin, Ohio.....	4	Apr. 10	Mar. 30, 1908
Detroit, Mich.....	3	Mar. 31	Mar. 17, 1905
Vicksburg, Mich.....	7	Apr. 7	Mar. 30, 1908
Point Pelee, Ont.....			Jan. 25, 1907
Guelph, Ont.....	4	Apr. 21	Apr. 13, 1895
Ottawa, Ont.....	16	Apr. 24	Apr. 16, 1897
Tampico, Ill.....	3	Apr. 10	Apr. 7, 1884
Chicago, Ill.....	16	Apr. 19	Mar. 29, 1907
Ripon, Wis.....			Apr. 12, 1879
La Crosse, Wis.....	5	Apr. 22	Apr. 8, 1909
Palmer, Mich.....	2	May 6	May 5, 1895
Central Iowa.....	12	Apr. 17	Apr. 4, 1890
Heron Lake, Minn.....	6	Apr. 20	Apr. 8, 1889
Elk River, Minn.....	4	Apr. 23	Apr. 9, 1887
Lake Andrew, Minn.....	4	Apr. 24	Apr. 19, 1893
White Earth, Minn.....			Apr. 17, 1880
Central Kansas.....	6	Apr. 17	Apr. 12, 1907
Kansas City, Mo.....	4	Apr. 18	Apr. 17, 1902
Valentine, Nebr. (near).....	4	Apr. 27	Apr. 21, 1896
Huron, S. Dak.....	3	Apr. 17	Apr. 12, 1884
Sioux Falls, S. Dak.....	2	Apr. 11	Apr. 10, 1910
Harrisburg, N. Dak. (near).....	6	May 2	Apr. 22, 1883
Aweme, Manitoba.....	10	May 3	Apr. 19, 1909
Indian Head, Sask. (near).....	6	May 11	May 1, 1910
Denver, Colo.....	7	Apr. 20	Apr. 10, 1897
Salida, Colo.....			Apr. 16, 1908
Utah Lake, Utah.....			Mar. 30, 1899
Terry, Mont.....			Apr. 23, 1893
Edmonton, Alberta.....	4	May 21	May 14, 1908
Fort Providence, Mack.....	2	May 9	May 6, 1904
Aumsville, Oreg.....	4	Mar. 28	Mar. 21, 1889
Grays Harbor, Wash.....			Apr. 3, 1890
Chilliwack, B. C.....			Mar. 17, 1889
Okanagan Landing, B. C.....	2	Apr. 26	Apr. 23, 1908

The last bittern seen in the spring at Nassau, Bahamas, was on March 6, 1902 (Bouhote); Frogmore, S. C., April 4, 1887 (Hoxie); New Orleans, La., April 7, 1904 (Allison); Whitfield, Fla., April 22, 1903 (Worthington).

Eggs have been taken at Variety Mills, Va., May 12, 1884 (Micklem); Salem, N. J., May 28, 1904 (Stone); Lake Umbagog, Me., June 4, 1883 (Carpenter); Magdalen Islands, Quebec, July 14, 1887 (Bishop); Kewanee, Ill., May 22, 1893 (Murchison); Fays Lake, Mich., May 30, 1894 (Watkins); Detroit, Mich., May 21, 1899 (Swales); Leech Lake, Minn., June 6, 1902 (Currier); Julesburg, Colo., May 17, 1899 (Dawson); Alamitos, Los Angeles County, Cal., May 14, 1899 (Robertson); Fort Crook, Cal., May 12, 1861 (speci-

mens in U. S. National Museum); near Crane Lake, Saskatchewan, June 7, 1905 (Bent). Young out of the nest were found at Guelph, Ontario, at the early date of June 1, 1901 (Walker), and young a week old at Meridian, N. Y., May 31, 1898 (Tabor).

Fall migration.

Place.	Number of years' records.	Average date of the last one seen.	Latest date of the last one seen.
Chilliwick, B. C.			Dec. 19, 1889
Indian Head, Sask.	2	Oct. 15	Oct. 16, 1907
Whitford Lake, Alberta			Oct. 29, 1900
Aweme, Manitoba	2	Oct. 10	Nov. 5, 1909
Marstonmoor, N. Dak.			Nov. 9, 1909
Sioux Falls, S. Dak.	2	Nov. 7	Nov. 20, 1910
Barr Lake, Colo.			Dec. 28, 1904
Nebraska City, Nebr.			Nov. 8, 1909
Delavan, Wis.	3	Oct. 13	Oct. 16, 1894
Chicago, Ill.	5	Oct. 16	Nov. 28, 1895
Ottawa, Ont.	16	Oct. 23	Nov. 2, 1896
Palmer, Mich.			Oct. 31, 1894
Vicksburg, Mich.	5	Nov. 5	Nov. 12, 1902
Keokuk, Iowa.	4	Oct. 31	Nov. 9, 1903
Kansas City, Mo.			Nov. 23, 1904
Minerva, Ohio.			Nov. 10, 1892
Greensburg, Ind.			Dec. 25, 1892
North River, P. E. I.			Sept. 13, 1887
Montreal, Canada.	6	Oct. 22	Nov. 11, 1894
Scotch Lake, N. B.			Nov. 22, 1900
Pictou, N. S.			Oct. 20, 1894
Pittsfield, Me.	3	Oct. 6	Oct. 9, 1895
Nantucket Island, Mass.			Nov. 3, 1896
Canandaigua, N. Y.			Oct. 30, 1905
Renovo, Pa.	3	Oct. 21	Nov. 11, 1900
Erie, Pa.	3	Oct. 24	Oct. 28, 1893
Cape May, N. J.			Nov. 19, 1878
Chester County, Pa.			Dec. 8, 1879

The first in fall migration arrived at Frogmore, S. C., August 26, 1886 (Hoxie), and at St. Marys, Ga., September 12, 1905 (Arnow).

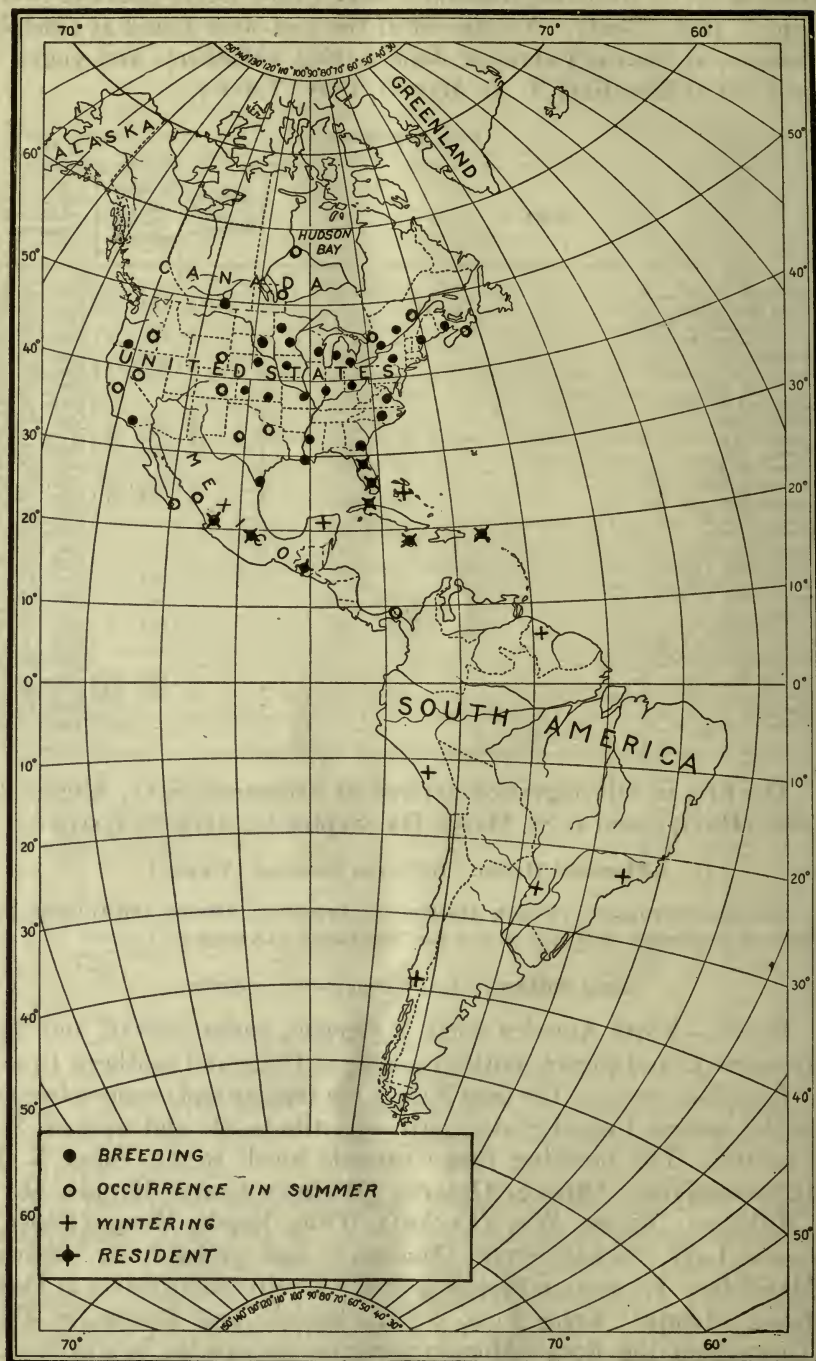
[**Pinnated Heron.** *Botaurus pinnatus* (Wagler).]

This species ranges in South America, in Argentina, Brazil, and Guiana, and has one somewhat doubtful record for Nicaragua (Lawrence).]

Least Bittern. *Ixobrychus exilis* (Gmelin).

Range.—North America north to Oregon, Saskatchewan, and New Brunswick, and thence south in winter to Chile and southern Brazil.

Breeding range.—The least bittern is a regular and common breeder in the eastern United States north of latitude 39° and west of New England. The breeding range extends north to St. John, N. B. (Chamberlain); Ottawa, Ontario (White); Grand Rapids, Mich. (Milliken); Ripon, Wis. (Cooke); White Earth, Minn. (Cooke); Crane Lake, Saskatchewan (Macoun); and probably in southern Manitoba. Its western limit is near the hundredth meridian at Hays, Kans. (Lantz); Long Pine, Nebr. (Bates); and Roscoe, S. Dak. Throughout the Rocky Mountain region the species is absent as a breeder, but appears again in small numbers along the Pacific coast at San Luis Rey, Cal. (Sharp); Los Angeles, Cal. (Grinnell); and

FIG. 10.—Least bittern (*Ixobrychus exilis*).

Tule Lake, Oreg. (Bailey). It breeds rarely along the Atlantic coast from Washington, D. C. (Coues), to Raleigh, N. C. (Brimley), and Lake Ellis, N. C. (Philipp), and more commonly on the coast of South Carolina (Wayne), in Georgia (Perry), throughout most of Florida, and along the Gulf coast to the mouth of the Rio Grande (Merrill). There is thus a large part of the eastern United States south of the thirty-ninth parallel and back from the coast in which the species is either lacking or very rare.

The least bittern nests locally in a few places in central Mexico—Ocotlan, Jalisco (Nelson); La Laguna, Jalisco (Nelson); Patzcuaro, Michoacan (Stone); and the valley of Toluca (Goldman). It breeds also in Cuba (Gundlach); and Porto Rico (Gundlach).

Winter range.—The least bittern winters north to Micanopy, Fla. (Baynard); and Orlando, Fla. (Hyer); also in the Bahamas (Bonhote). In Mexico it occurs in winter north to San Blas, Tepic (Lawrence); Lake Patzcuaro, Michoacan (Jouy); and the valley of Toluca (Goldman). Thence it ranges south to Lion Hill, Panama (Sharpe); Georgetown, Guiana (Loat); Iguape, Brazil (Ihering); Paraguay (Berlepsch and Stolzmann); and to Valdivia, Chile (Boeck).

Migration range.—Records of migration or of wandering have been made at Halifax, N. S., March 16, 1896 (Piers); Quebec City, Canada (Dionne); Beaumaris, Ontario (Fleming); Shoal Lake, Manitoba, June, 1901 (Chapman); San Angelo, Tex., September 10, 1885 (Lloyd); Fort Thorn, N. Mex. (Henry); Boulder, Colo., May 25, 1910 (Betts); Cheyenne, Wyo. (Knight); Truckee Valley, Nev. (Ridgway); Malheur Lake, Oreg. (Bendire); Mazatlan, Sinaloa, September (Lawrence); San Jose del Cabo, Lower California, common in the fall (Brewster).

Spring migration.

Place.	Number of years' records.	Average date of spring arrival.	Earliest date of spring arrival.
Savannah, Ga.			Mar. 6, 1908
Frogmore, S. C.			Apr. 5, 1888
Manteo, N. C.			Apr. 20, 1899
Raleigh, N. C.	2	May 5	May 3, 1889
Washington, D. C.	3	May 20	May 18, 1907
Erie, Pa.	5	May 23	May 19, 1892
Williamsport, Pa.			May 6, 1896
Brockport, N. Y.			May 5, 1894
Providence, R. I.			Feb. 28, 1881
Belmont, Mass.			May 11, 1876
Opelousas, La.			Apr. 13, 1837
Corpus Christi, Tex.			Apr. 5, 1889
Escondido, Cal.			Mar. 28, 1896
Quincy, Ill.	4	Apr. 27	Apr. 22, 1888
Turlington, Nebr.			May 6, 1900
Oberlin, Ohio.	6	May 1	Apr. 25, 1904
Waterloo, Ind.	3	May 3	Apr. 30, 1907
Chicago, Ill.	6	May 14	May 6, 1890
Southwestern Ontario.	8	May 16	May 13, 1905
White Earth, Minn.	2	May 11	May 10, 1881
Heron Lake, Minn.	4	May 18	May 9, 1889
Sioux Falls, S. Dak.			May 11, 1903

Eggs have been taken at Fort Thompson, Fla., March 25, 1893 (specimens in U. S. National Museum); Titusville, Fla., April 10, 1905 (Worthington); St. Johns, Fla., April 18, 1902 (Bent); Rodney, Miss., May 10, 1887 (Mabbett); Raleigh, N. C., May 23, 1893 (young in nest) (Brimley); Philadelphia, Pa., May 29, 1907 (Miller); Portland, Conn., June 10, 1883 (Neff); Oak Forest, Ind., May 21, 1902 (Honecker); Canton, Ill., May 28, 1884 (Cobleigh); Des Moines, Iowa, May 26, 1885 (Keyes); Detroit, Mich., May 26, 1891 (Wood); Fort Snelling, Minn., May 28, 1903 (specimens in U. S. National Museum); Mud Lake, Minn., June 3, 1887 (Brownell). Eggs have been found in Porto Rico on May 7 (Gundlach); in Jamaica from May 29 (Field) to June 25 (Scott); in Guatemala June 1 (Oates); and at Purissima, Lower California, May 17, 1909 (Thayer).

Fall migration.—The latest fall date of the least bittern at Montreal, Canada, was on September 2, 1897 (Wintle); Middletown, R. I., September 14, 1901 (King); Erie, Pa., September 25, 1902 (Todd); Washington, D. C., September 19, 1881 (Richmond); Waterloo, Ind., October 1, 1906 (Link); Vicksburg, Mich., October 5, 1903 (Corwin); Oberlin, Ohio, October 17, 1909 (Jones); Indianola, Iowa, October 18, 1902 (Jeffrey); Toronto, Ontario, November 28, 1894 (Fleming); Dunlap, Cal., September 24, 1890 (Eaton); Sioux Falls, S. Dak., October 8, 1911 (Larson); Lincoln, Nebr., September 20, 1900 (Wolcott); Corpus Christi, Tex., September 29, 1886 (Sennett); and Bermuda, October 23, 1847 (Hurdis).

The earliest fall record at Lima, Peru, was on October 10, 1889 (Berlepsch and Stolzmann).

Cory Least Bittern. *Ixobrychus neoxenus* (Cory).

The Cory least bittern has a strange distribution, judging from the little as yet learned about the species. It is known to breed at the northern limit of the range in Ontario and also at its southern limit in Florida. It is known as a migrant only in the intervening region and is not known in winter anywhere.

It has been found nesting near Toronto, Ontario, and near Fort Thompson, Fla.; at the former place eggs were found June 15, 1898 (Fleming), and at the latter, young in the nest, June 8, 1890 (Scott). Near Toronto about 16 specimens have been taken in the summer, the earliest date being May 14, 1897, and the latest September 9, 1899, and young birds have been found from August 3 to 17. One specimen has been secured at each of the following localities: Watkins Lake, Jackson County, Mich., August 8, 1894 (Watkins); St. Clair Flats, Mich., May 14, 1904 (Taverner); Toledo, Ohio, May 25, 1907 (Ruthven); Lake Koshkonong, Wis., May 22, 1893 (Cherrie); and Scituate,

Mass., May 18, 1901 (Brewster). The above are probably all the records that have been published for this species north of Florida.

The records in this latter State come from a restricted area in the vicinity of the western side of Lake Okechobee and extend over the three summer months from May 19, 1890, to August 15, 1891. A number of specimens have been taken, showing that the bird is not rare in that region, but so far there are no winter records for the species anywhere, and nothing to indicate where the birds spend the time from September to May.

Great White Heron. *Ardea occidentalis* Audubon.

The great white heron has the most restricted range of any of the herons of North America. It is confined during the breeding season to the extreme southern part of Florida, where it has been known to nest from Indian Key (Audubon); west to Marquesas Key (Fowler); and north to Cape Romano (Scott).

It is normally non-migratory, but a few individuals have wandered north on the east coast of Florida to Brevard County (Chapman); in the interior to Cypress Lake (Palmer); and on the west coast to Anclote River (Scott). South of the United States it has been taken on the Rio Lagartos, Yucatan (Brown), in Jamaica (March), and near Trinidad, Cuba (Chapman). Eggs have been taken on the Florida Keys from October (Scott) all through the winter and spring to the middle of June (Thayer).

Great Blue Heron. *Ardea herodias herodias* Linnæus.

Range.—The great blue heron with its several subspecies ranges from ocean to ocean and north to southern Canada and southern

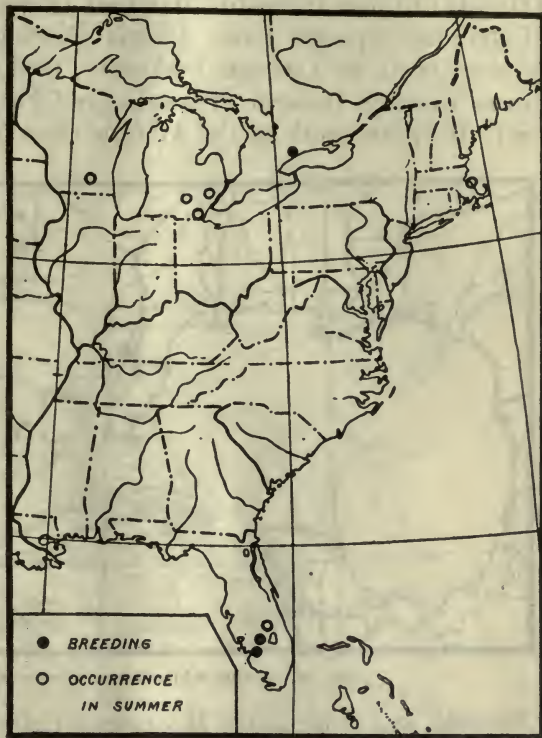


FIG. 11.—Cory least bittern (*Ixobrychus neoxenus*).

Alaska. It occurs throughout Mexico, Central America, Bermuda, the Bahamas, and the West Indies, while a few birds have been recorded from northern South America and from the Galapagos Islands.

Breeding range.—The typical form *herodias* breeds north to Baddeck, N. S. (Dwight); Magdalen Islands, Quebec (Job); Chatham, N. B. (Baxter); Quebec City, Canada (Dionne); Cobalt, Ontario (Hubel); Riding Mountain, Manitoba (Seton); Osler, Saskatchewan (Colt); and Spotted Lake, Alberta (Loring). It has been known to occur north to Anticosti (Schmitt); Godbout, Quebec (Comeau); Moose Factory, Ontario (Turner); and Fort Chimo, Quebec (Turner). It breeds south on the Atlantic coast to Mount Pleasant, S. C.

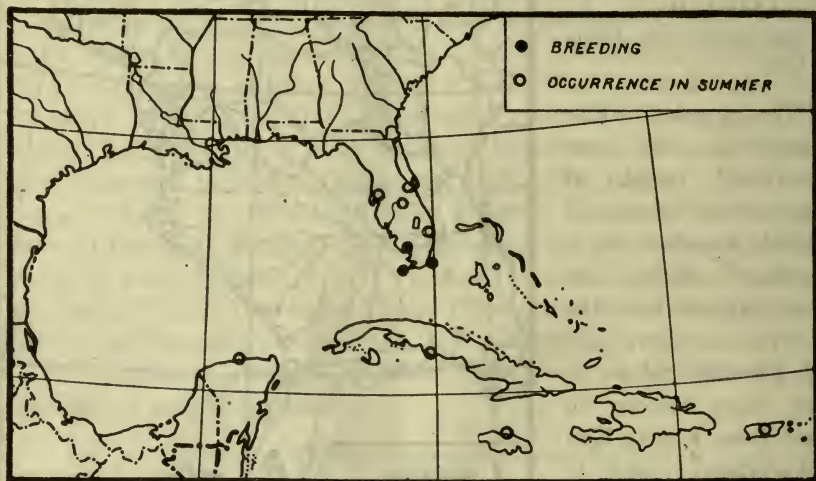


FIG. 12.—Great white heron (*Ardea accidentalis*).

(Wayne), and south in the Mississippi Valley to Winnebago County, Iowa (Abbott). It occurs west in migration to Prospect Lake, B. C. (specimen in American Museum of Natural History), and probably breeds in southeastern British Columbia.

The species once nested in Bermuda in 1846 (Wedderburn), but has since then been known there as a migrant only.

Winter range.—The regular winter range of typical *herodias* extends south to Micco, Fla. (Bangs); Castleberry, Ala. (Matthews); and to Camargo, Tamaulipas (Goldman). The species ranges north in winter to Raleigh, N. C. (Brimley); Cape Charles, Va. (Chapman); and to Fayetteville, Ark. (Harvey). In mild winters some individuals remain much farther north, as far as the lower Ohio Valley (Butler) and New Jersey (Fisher), while stragglers have been noted at Randolph, N. H., December 31, 1910 (Allen); Milton, Vt., December 22, 1884 (Howe); Boston Harbor, Mass., January 1,

1882 (Job); West Roxbury, Mass., January 1, 1890 (Faxon); Point Judith, R. I., December 11, 1899 (Hathaway); Bridgeport, Conn.,



FIG. 13.—Great blue heron (*Ardea herodias*). Subspecies: 1, *herodias*; 2, *wardi*; 3, *treganzai*; 4, *fannini*; 5, *hyperonca*; 6, *adoxa*; 7, *lessoni*; 8, *sanctilucae*; 9, *cognata* (Galapagos, not shown on map); 10, South American birds not yet determined or named.

January 1884 (Foster); Madison County, N. Y., January 12, 1900, and December 27, 1900 (Embody); Frankfort, Ind., January 14, 1903 (Ghere); Lansing, Mich., December 23, 1897 (Hawkinson).

Ward Heron. *Ardea herodias wardi* Ridgway.

The form of the great blue heron breeding in Florida has received the name of *wardi*. It includes not only all the Florida breeding birds, but also those breeding on the Atlantic coast north to Hilton-head, Beaufort County, S. C. (Prentiss); along the Gulf coast to Corpus Christi, Tex. (Sennett); and up the middle of the Mississippi Valley to Knox County in southwestern Indiana (Ridgway); and Henry County in southeastern Iowa (Savage).

This form is resident throughout its range with the exception of those individuals that migrate up the Mississippi Valley. These retire in the fall to spend the winter on the Gulf coast. A specimen taken December 25, 1902, at Ocotlan, Jalisco (Nelson and Goldman), apparently represents a bird that had wandered far from its normal range.

Treganza Heron. *Ardea herodias treganzai* Court.

The large, dark, great blue herons of the Mississippi Valley are cut off from those of the Pacific by a small pale form occupying the Great Basin and the semiarid regions to the eastward. This form has been separated under the name of *treganzai*, and birds of this character breed north at least to Douglas, Wyo. (Dwight); Gallatin, Mont. (Richmond); and Grace, southeastern Idaho (Walcott); and south to the Salton Sea, Cal. (Grinnell).

During migration it spreads westward into California to the Sacramento Valley (Williamson).

It ranges south in winter to the lower Rio Grande Valley of Texas (Dwight); and in northern Mexico south to Colima (Nelson and Goldman); while it remains in winter north to Fort Clark, Tex. (Mearns); Dona Ana, N. Mex. (Henry); and St. George, Utah (Bailey).

Northwestern Coast Heron. *Ardea herodias fannini* Chapman.

As its name implies, the northwestern coast heron is confined to the Pacific coast. It is known to breed north to Glacier Bay, Alaska (Grinnell), and it probably breeds still farther north, for it was seen occasionally during the summer of 1906 near Yakutat Bay (Blackwelder); and at Hope, Cook Inlet, during August, 1900 (Heller). This form breeds south to Cape Flattery, Wash. (Trowbridge); and to Nisqually Flats near Tacoma, Wash. (Rhoads).

Alaska is deserted in winter, and most of the individuals spend this season in the vicinity of Puget Sound north to Chilliwack, B. C. (Brooks).

California Great Blue Heron. *Ardea herodias hyperonca* Oberholser.

The great blue herons of the Pacific coast from Oregon to southern California have lately been segregated by Oberholser under the name of *hyperonca*. A specimen from Oregon (Peale) without any definite locality indicates the probability that the coast-breeding birds of that State should be assigned to this form, and thence it extends south to San Diego, Cal. (Cooper). How far back from the coast this form ranges, and to which form should be assigned the great blue herons of the interior valleys of California are points not yet decided.

West Indian Great Blue Heron. *Ardea herodias adoxa* Oberholser.

According to Oberholser, who has recently described this form, this subspecies includes all the breeding birds of the entire Greater and Lesser Antilles, with the addition of the Bahamas on the north and Curaçao Island off the coast of Venezuela on the south. A strange fact in the life history of this form is that it is a pronounced migrant. It is known in the winter season as a not rare visitant to the whole Lesser Antilles, but is not known to breed on any of them, nor is it probable that it breeds on either Porto Rico or Haiti. While fairly common in winter on many of the Bahamas, it has not yet been found breeding on any of them, though birds have been noted at what might have been and probably was the breeding season. The species is recorded as more common in Jamaica during the winter than in summer, hence no great numbers probably leave this island.

The status of the birds of the Isle of Pines and of Cuba, in which latter country it is a common breeder, remains entirely unsettled, nor is it known whether they belong to this new form or to *wardi*. The most that can be said at present is that the great blue heron is a winter resident in Haiti, Porto Rico, and the Lesser Antilles south to the islands of Trinidad and Curaçao, but that there is nothing certain known as yet concerning the summer home of these individuals.

Mexican Great Blue Heron. *Ardea herodias lessoni* Wagler.

Many years ago the great blue herons of the mainland of Mexico were named as above and these birds breed in favorable localities over much of Mexico south to Guerrero and east to Campeche. They occur as migrants and winter residents throughout the whole of Central America to central Costa Rica.

The status of the great blue herons of northwestern South America is not yet settled, but the bird occurs in the breeding season from

Merida, Venezuela, to the Canal Zone, Panama, and also winters in this region and on the islands off the north coast of Venezuela.

Lower California Great Blue Heron. *Ardea herodias sanctilucae* Thayer and Bangs.

The name *sanctilucae* applies to the birds of the Cape region of Lower California, where they have been found breeding on San Jose and Espiritu Santo Islands and wintering south to San Jose del Cabo.

Galapagos Great Blue Heron. *Ardea herodias cognata* Bangs.

Restricted to the Galapagos Islands, where it is a constant resident.

Migration and breeding of the Great Blue Heron and its subspecies.

The following records of migration and breeding are not separated according to subspecies, but it is easy to tell from the preceding statements of range which particular form is intended:

Spring migration.

Place.	Number of years' records.	Average date of spring arrival.	Earliest date of spring arrival.
Raleigh, N. C.	5	Apr. 2	Rare, winter.
Weaverville, N. C.	3	Apr. 6	Mar. 29, 1894
Lick Run, Va.	3	Apr. 1	Mar. 27, 1888
White Sulphur Springs, W. Va.	4	Apr. 6	Apr. 4, 1898
Washington, D. C.	6	Apr. 3	Jan. 21, 1912
Erie, Pa.	5	Apr. 5	Mar. 27, 1902
Renovo, Pa.	6	Apr. 15	Mar. 24, 1903
Morristown, N. J.	4	Apr. 9	Mar. 27, 1886
Branchport, N. Y.	12	Mar. 31	Mar. 24, 1899
Canandaigua, N. Y.	3	Mar. 25	Mar. 24, 1906
Bridgeport, Conn.	4	Apr. 9	Apr. 4, 1905
Hartford, Conn.	5	Apr. 11	Apr. 4, 1897
Jewett City, Conn.	6	Apr. 12	Mar. 27, 1901
Fitchburg, Mass.			Mar. 20, 1898
Framingham, Mass. (near).	5	Apr. 12	Apr. 6, 1887
Southern New Hampshire.	9	Apr. 16	Mar. 28, 1908
Plymouth, Me.	7	Apr. 11	Apr. 6, 1879
Westbrook, Me.	4	Apr. 15	Mar. 24, 1894
Portland, Me.	5	Apr. 15	Apr. 9, 1905
Grand Manan, New Brunswick.	3	Apr. 8	Apr. 3, 1889
St. John, New Brunswick.	5	Apr. 12	Apr. 3, 1892
Scotch Lake, New Brunswick.	10	Apr. 11	Mar. 30, 1902
Halifax, Nova Scotia (near).	3	Apr. 17	Mar. 31, 1904
North River, Prince Edward Island.	3	Apr. 12	Apr. 8, 1888
Quebec City, Canada.	3	Apr. 16	Apr. 14, 1905
Shawneetown, Ill.	2	Mar. 9	Mar. 7, 1885
Gilman City, Mo.	4	Mar. 18	Mar. 16, 1904
Camden, Ind.	4	Mar. 19	Feb. 14, 1885
La Porte, Ind.	4	Mar. 29	Mar. 26, 1893
Waterloo, Ind.	7	Mar. 30	Mar. 23, 1887
Chicago, Ill.	5	Mar. 31	Feb. 28, 1890
Rockford, Ill.	6	Mar. 31	Mar. 21, 1893
Youngstown, Ohio.			Mar. 12, 1909
Sandusky, Ohio.	12	Apr. 1	Mar. 13, 1907
Oberlin, Ohio.	8	Apr. 1	Mar. 20, 1897
Detroit, Mich.	2	Mar. 13	Mar. 11, 1891
Vicksburg, Mich.	6	Mar. 25	Mar. 16, 1908
Petersburg, Mich.	7	Mar. 30	Mar. 17, 1897
Plymouth, Mich.	5	Apr. 2	Mar. 30, 1897
Plover Mills, Ontario.	5	Mar. 31	Mar. 23, 1897
Dunnville, Ontario.	4	Apr. 2	Mar. 29, 1897
Guelph, Ontario.	6	Apr. 4	Mar. 26, 1902
Toronto, Ontario.	4	Apr. 9	Feb. 1, 1891

Spring migration—Continued.

Place.	Number of years' records.	Average date of spring arrival.	Earliest date of spring arrival.
Ottawa, Ontario.....	15	Apr. 11	Apr. 3, 1909
Sault Ste. Marie, Ontario.....			Apr. 19, 1884
Hillsboro, Iowa.....	5	Mar. 25	Mar. 22, 1897
Indianola, Iowa.....	5	Mar. 26	Mar. 21, 1901
Grinnell, Iowa.....			Feb. 12, 1880
Laporte, Iowa.....	5	Mar. 29	Mar. 21, 1886
Madison, Wis. (near).....	8	Apr. 9	Apr. 1, 1892
Meridian, Wis.....			Apr. 5, 1897
Lake Andrew, Minn.....	7	Apr. 3	Mar. 27, 1895
Heron Lake, Minn.....	7	Apr. 5	Apr. 1, 1889
Elk River, Minn.....	7	Apr. 5	Mar. 21, 1907
White Earth, Minn.....			Apr. 14, 1882
Richmond, Kans. (near).....	7	Mar. 25	Mar. 17, 1885
Nebraska City, Nebr. (near).....	4	Apr. 11	Mar. 21, 1896
Reaburn, Manitoba.....	5	Apr. 19	Apr. 15, 1902
Indian Head, Saskatchewan.....	3	May 9	Apr. 20, 1907
Salida, Colo.....			Mar. 19, 1909
Denver, Colo. (near).....	8	Apr. 2	Mar. 24, 1908
Cheyenne, Wyo.....			Apr. 3, 1885
Sheridan, Wyo.....			Apr. 13, 1907
Terry, Mont.....	4	May 7	May 2, 1905
Brownfield, Alberta.....			May 7, 1907

In the southern part of the breeding range the time of nesting is variable. Gundlach found eggs in Cuba through all the months from September to January. Eggs were taken on the Galapagos September 2, 1897 (Rothschild and Hartert). The young found February 5, 1910, at Upper Matecumbe Key, Fla. (Brodhead), were hatched from eggs that must have been laid in December, while at Charleston, S. C., Wayne says that the earliest eggs are deposited the middle of March and that eggs are most common in late March. Young were in the nest May 25, 1875, at Cobb Island, Va. (Bailey); eggs at Wilmington, Del., April 29, 1906 (Pennock); Tully, N. Y., April 29, 1884 (Dakin); Penn Yan, N. Y., May 3, 1896 (Burtch); Oneida Lake, N. Y., May 1, 1884 (Northup); Little Spruce Island, Me., May 16, 1896 (Knight); Kentville, N. S., May 10 (Bishop); Camden, Ind., May 21, 1883 (Evermann); New Bremen, Ohio, April 27, 1908 (Henninger); Dorset, Ohio, May 12, 1900 (Keck); Sunfield, Mich., May 2, 1891 (White); Minneapolis, Minn., May 8, 1888 (Morrison); San Jose Island, Lower California, February 15-18, 1909 (Thayer); Refugio County, Tex., late February, 1896 (Strecker); Beaumont, Tex., March 22, 1887 (Rachford); Laramie, Wyo., May 12, 1901 (Gilmore); Terry, Mont., April 23, 1905 (Terry); San Diego, Cal., April 24, 1861 (Cooper); Napa, Cal., April 4, 1901 (Hottel); Malheur Lake, Oreg., April 16, 1875 (Bendire); and Sumner, Wash., April 20, 1905 (Bowles). Young were noted at Isabella Island, Mexico, April 10, 1905 (Bailey); fledged young at Redwood City, Cal., April 14, 1907 (Carriger and Pemberton); and young three weeks old near Salt Lake City, Utah, April 9, 1907 (Treganza).

Fall migration.

Place.	Number of years' records.	Average date of the last one seen.	Latest date of the last one seen.
Flagstaff, Alberta.....			Sept. 23, 1906
Terry, Mont.....	2	Sept. 21	Sept. 24, 1905
Littleton, Colo.....			Nov. 3, 1908
Margaret, Manitoba.....	3	Sept. 13	Sept. 15, 1910
Sioux Falls, S. Dak.....	2	Oct. 26	Oct. 31, 1909
Nebraska City, Nebr.....			Nov. 8, 1909
Lanesboro, Minn.....	5	Sept. 17	Oct. 1, 1892
Keokuk, Iowa.....	4	Oct. 10	Nov. 11, 1900
Lake Forest, Ill.....			Nov. 22, 1906
Ottawa, Ontario.....	13	Nov. 1	Nov. 17, 1909
Southwestern Ontario.....	6	Oct. 24	Dec. 1, 1906
Vicksburg, Mich.....	5	Nov. 2	Nov. 18, 1902
Northern Ohio.....	4	Nov. 12	Dec. 19, 1910
North River, Prince Edward Island.....	4	Oct. 16	Oct. 20, 1890
Pictou, Nova Scotia.....			Oct. 11, 1894
Scotch Lake, New Brunswick.....	4	Nov. 5	Nov. 8, 1904
St. John, New Brunswick.....	7	Oct. 14	Oct. 30, 1889
Quebec City, Canada.....			Oct. 4, 1894
Montreal, Canada.....	7	Oct. 31	Nov. 13, 1897
Pittsfield, Me.....	4	Oct. 24	Nov. 13, 1896
Woods Hole, Mass.....	4	Nov. 1	Nov. 21, 1891
Renovo, Pa.....	4	Oct. 17	Nov. 10, 1911
Erie, Pa.....			Nov. 22, 1902
Washington, D. C.....			Dec. 5, 1894
Weaverville, N. C.....			Oct. 11, 1890

European Heron. *Ardea cinerea* Linnæus.

The European heron is entitled to a place in the list of North American birds solely on the strength of its occurrence in Greenland, where it has been taken several times. It is recorded from Nanortalik, 1856, Godthaab, 1862, and January 14, 1877, and Nunarsuit, 1888, all these places being on the west coast; from Eggers Island, at the south extremity of Greenland, the fall of 1893; and once from the east coast.

This heron has a wide distribution in the Eastern Hemisphere, ranging north in Europe and Asia to about latitude 60°, and south to southern Africa, Madagascar, southern Asia, the Malay Islands, and Australia.

Egret. *Herodias egretta* (Gmelin).

Range.—The Gulf States and Mexico and north to Oregon, Wisconsin, and New Jersey; the West Indies, Middle and South America to Patagonia; has wandered north to Manitoba and Nova Scotia.

Breeding range.—In the case of the egret a distinction must be made between the present and the former breeding range, because this is one of the species which has been almost exterminated for the sake of obtaining the dorsal plumes known as aigrettes that are borne at the breeding season. Fifty years ago, before the demands of fashion had called for its slaughter, the egret nested in great colonies in Florida, the other Gulf States, and several States of the

FIG. 14.—Egret (*Herodias egretta*).

Mississippi Valley. The nests were usually placed on large trees growing in water, and hence the colonies were restricted to the heavy swamps near the coast or to the bottom lands of the larger rivers inland. The birds nested commonly north along the Atlantic coast to Charleston, S. C. (Audubon). They undoubtedly nested in some of the many favorable localities on the coasts of North Carolina and Virginia, where actual records are very few, and thence north to southern New Jersey, where in Wilson's time a small colony bred near Cape May. The egret once nested in Arlington Cemetery, Virginia, near Washington, D. C. (Wm. Palmer).

The bottom lands of the Mississippi River and its larger tributaries furnished an abundance of suitable nesting sites, and here were the largest colonies outside of Florida. As many as a thousand birds have been seen in a single colony in Daviess County, Ind. So generally distributed were these herons in Indiana that they have been known to nest in Knox, Gibson, Daviess, Dekalb, Steuben, Noble, Jasper, Porter, Lake, and Starke Counties. The southern third of Indiana marked the northern limit of the larger breeding colonies, but smaller colonies nested north to northern Indiana and even two-thirds of the way up the western shore of Lake Michigan to Two Rivers, Wis. (Kumlein and Hollister). The egret also nested as far north as Grand Ridge, Ill. (Soule); Canton, Ill. (Cobleigh); Lincoln County, Mo. (Widmann); and Texarkana, Tex. (Oberholser).

The Great Plains and the Rocky Mountain region offered little inducement to the egret, and it seems to have been absent during the breeding season from the whole of this great area except that a few nested near Great Salt Lake, Utah (Ridgway). A few small colonies existed in California, at Buena Vista Lake (Linton); Summit Lake (Goldman); and Sacramento (Ridgway); also in the Truckee Valley, Nev. (Ridgway); and north to Malheur Lake, Oreg. (Bendire), which was formerly the home of probably the largest colony on the Pacific slope. Here, contrary to their habit in most parts of their range, the birds were necessarily forced to nest among the reeds.

South of the United States the former breeding range of the egret seems to have included all of Central America and the whole of South America south to Port Otway, Patagonia (Sclater and Salvin). It is to be understood, of course, that the species was very local throughout this whole region, being restricted to the few places favorable for nesting sites situated principally on the coasts, the larger lakes, and the borders of the lower parts of the larger rivers, especially the Parana, the Paraguay, and the upper Orinoco. The egret nested on the four large islands of the Greater Antilles, but seems to have been rare in the West Indies east of

Porto Rico, though recorded from Dominica (Verrill), Barbados (Manning), and Trinidad (Leotaud), and from the islands of New Providence, Andros, Eleuthera, Watlings, and Long, in the Bahamas (Riley). It nested on the Galapagos (Rothschild and Hartert).

Many herons have the strange habit of migrating northward after the breeding season and are often common for several weeks in the fall in districts far north of the breeding range. The egret is a conspicuous example of birds with this habit, and these northward movements in the fall have brought them to many places in Ohio, New York, and New England, and north to Halifax, N. S. (Jones); Grand Manan, N. B. (Deane); Calais, Me. (Boardman), near Portland, Me. (Knight); Godbout, Quebec (Comeau); Montreal, Canada (Wintle); Rockcliffe, Ontario (McIlwraith); Lake Nipissing, Ontario (Seton); Rondeau, Ontario (McIlwraith); Kalamazoo, Mich. (Gibbs); Lanesboro, Minn. (Hvoslef); also northwestward in the Missouri River Valley to Emporia, Kans. (Kellogg); Fairbury, Nebr. (Swenk); Colorado Springs, Colo. (Aiken); Denver, Colo. (Rockwell); Barr, Colo. (Hersey and Rockwell); Badger Lake, Iowa (Lewis and Clark); Fort Lincoln, N. Dak. (Grinnell); and even north to Lake Winnepigosis, Manitoba (Seton).

The above statement represents the range of the egret before the demands of the millinery trade had so woefully depleted its numbers. Now the great colonies are entirely a thing of the past. The plume hunter has made a clean sweep of all the heronries that were large enough to make their exploitation profitable. Nor has the destruction been confined to the birds of the United States. The same story of wholesale slaughter comes from Mexico, Central America, the West Indies, and lastly from South America. It is probable that the largest colonies still in existence are to be found in Venezuela or near the equator, but even in these regions, remote and difficult of access, the high market value of the plumes has proved a sufficient incentive for the overcoming of all hardships, and the colonies remaining are but a small part of the original numbers. A few small colonies still exist in widely separated parts of Florida, where breeding birds have been reported during the last few years from Monroe County (Bent); Kissimmee (Beers); Sebastian (Chapman); Orange Lake (Baynard); and Tallahassee (Williams). The species nested in 1910 near Charleston, S. C. (Wayne); a small flock was seen during the breeding season of 1909 near Ellis Lake, N. C. (Philipp); and a few birds nested in 1911 near Orton, Brunswick County, N. C. (Brimley). It nested in 1908 near the delta of the Mississippi, La. (Bowditch); and there were a few nests in 1910 at Walkers Lake, Ark. (Widmann). On the Pacific slope, the great heronry at Malheur Lake, Oreg., has been wiped out, except a few

birds that still lingered in the vicinity in 1911, and the few remaining birds of California are to be found in the vicinity of Tulare Lake (Goldman) and Clear Lake (Finley). Birds still wander north occasionally in the fall and during the last 10 years have been recorded from Eastham, Mass., 1911 (Cobb); Plymouth, Mass., 1911 (Farley); Marshfield, Mass., 1911 (Barrett); East Greenwich, R. I., August 16, 1904 (Allen); Point Judith, R. I., August 2, 1909 (Howe); Connecticut, 1911 (Howes); Montauk, N. Y., July 23, 1900 (Braislin); Ontario County, N. Y., August, 1905 (Reed); East Windham, N. Y., July 18, 1906 (Weber); Ridgwood, N. J., July, 1902 (Hales); Wading River, N. J., August, 1905 (Stone); Englewood, N. J., July 22, 1906 (Lemmon); Black Point, N. J., July 6, 1908 (Howe); Seabright, N. J., August 5, 1908 (Howe); Berwyn, Pa., July 26, 1902 (Burns); Bristol, Pa., July 20, 1906 (Harlow); Ashbourne, Pa., July 30, 1906 (Harlow); Washington, D. C., August 19 to 24, 1912 (Appel); Cincinnati, Ohio, August, 1902 (Stone); West Huron, Ohio, September, 1911 (Klein); Waterloo, Ind., April 22, 1905 (Link); Nehawka, Nebr., May 2, 1905 (Swenk); near Denver, Colo., April 26, 1907 (Rockwell); and Lawen, Oreg., May 5, 1909 (Hibbard).

Winter range.—The egret is resident throughout its range in Central and South America and the Greater Antilles. In the United States it winters in the southern half of Florida north to Gainesville (Chapman); on the coast of Louisiana (Beyer); on the coast of Texas (Audubon); and in southern California north to Santa Cruz (Breninger); and San Rafael (Mailliard). One was taken January 8, 1878, near Fort Klamath, Oreg. (Mearns), but the species does not winter regularly in that locality.

Spring migration.—The egret breeds so little north of its winter home that its regular migrations are short and quickly accomplished. Most of the movements are in March and early April, as shown by the following dates of spring arrival: Cumberland, Ga., March 7, 1902 (Helme); Charleston, S. C., March 28, 1909 (Weston); Rodney, Miss., March 22, 1889, and March 19, 1890 (Mabbett); St. Louis, Mo., April 9, 1886 (Widmann); Canton, Ill., April 11, 1895 (Cobleigh); Bloomington, Ind., April 10, 1887 (Evermann); near Vincennes, Iowa, April 17, 1894 (Currier); Tucson, Ariz., April 23, 1881 (Brewster); Fresno County, Cal., April 5, 1890 (Eaton); and Stockton, Cal., April 1, 1878 (Belding).

The egret breeds through such a wide range of latitude, both north and south of the equator, that it is natural that the nesting dates should show a wide variation. At the south end of the range in Chile and Argentina the height of the nesting season is in October and November; British Guiana, eggs in June (Lloyd); Haiti, February 18, 1895 (Christy); Cuba, March to June (Gundlach); Port

Henderson, Jamaica, June 25, 1890 (Field); Lake Okechobee, Fla., February 4, 1896 (Stone); Gainesville, Fla., June 14, 1893 (specimens in U. S. National Museum); near Charleston, S. C., April 7, 1910 (Wayne); Brownsville, Tex., young half grown May 15, 1877 (Sennett); eggs near Corpus Christi, Tex., April 4, 1882 (specimens in U. S. National Museum); Camp Harney, Oreg., April 16, 1877 (Bendire).

Fall migration.—The northward migration after the close of the breeding season begins in early July, and by the middle of the month the young birds are far north of the home of their birth. These wanderings last for a month to six weeks, and by late August or early September most of the birds have returned to the winter home. Occasionally a few birds remain in the north much later: Stockton, Cal., December 7, 1878 (Belding); near Richmond, Me., August 20, 1896 (Knight); Nantucket, Mass., September 20, 1890 (Mackay); Ipswich, Mass., November 22, 1892 (Vickary); Orleans County, N. Y., November 28, 1883 (Davison); Marcy, N. Y., November 10, 1889 (Ralph and Bagg); Jamaica Bay, N. Y., October 1, 1897 (Braislin); Ocean City, Md., September 23, 1894 (Taylor); and St. Louis, Mo., September 2, 1896 (Widmann).

Snowy Egret. *Egretta candidissima* (Gmelin).

Range.—The Western Hemisphere from Chile and Argentina north to the Gulf States and Mexico; has wandered north to Nova Scotia, Ontario, and British Columbia.

Breeding range.—The snowy egret is another plume bird which, like the larger egret, has been sadly diminished in numbers by the demands of fashion for the beautiful aigrettes that are carried during the breeding season. In fact, the snowy egret has suffered a severer persecution than any other heron and has been practically exterminated over large areas where once it was common. Formerly this species had a wide distribution, breeding abundantly in the Gulf States and commonly along the Atlantic to Charleston, S. C. (Wayne). Smaller colonies occurred on the coast of North Carolina and Virginia, and a large colony near Cape May, N. J., marked the northern limit of the breeding range. This last colony was visited by Wilson in 1812 and found to cover an extensive area. It was still well populated in 1886, but in 1888 only one pair remained, and the explanation was: "They have been almost exterminated, though formerly very abundant, one ornithologist having recently shot 73 birds in one day" (Parker).

Though abundant as a breeder near the mouth of the Mississippi, the snowy egret seems never to have nested in large colonies far back from the coast. In Audubon's time the bird was fairly common north to Memphis, Tenn., but only a few have nested to the northward, and their northern limit seems to have been reached in Knox



FIG. 15.—Snowy egret (*Egretta candidissima*).

County, Ind. (Ridgway). The nesting of this species, June, 1895, at Lincoln, Nebr. (Eiche), was probably fortuitous.

West of Louisiana numbers of this species become less, though it nested at favorable localities along the whole Texas coast, and there was a large colony near the mouth of the Rio Grande (Merrill); it also nested up some of the larger streams to Tarkington (Gaut) and Texarkana (Oberholser). As a breeder it was absent from the whole Rocky Mountain region and Pacific slope of the United States, the northern limit of the breeding range on the Pacific being found near San Jose Island, Lower California (Brown), and Rosario, Sinaloa (Nelson).

The snowy egret nested on both coasts of Mexico and on the larger interior waters. These breeding haunts were invaded by the plume hunters after the United States birds had been killed off and for several years furnished large shipments of aigrettes. Even as late as 1900 some of these colonies had not yet been destroyed. In the spring of that year, at Paligada, Tabasco, the owner of a tract of land containing a large heronry sold for a thousand dollars the right to shoot them, and the birds were exterminated that season. The breeding range also included the lower parts of Central America and South America, south to Valdivia, Chile (Boeck), and to Cape San Antonio, Argentina (Gibson). The species was also a common breeder in the Greater Antilles and less common in the Lesser Antilles, but seems to have been rare in the Bahamas, being recorded only from Inagua (Cory) and Great Bahama (Cory), while only a few specimens have been taken in Bermuda at the times of spring and fall migration.

The snowy egret has the same habit as the larger egret (*Herodias egretta*) of migrating north of the breeding grounds, though the number of such migrants has not been so great nor have the wanderings been so extensive as in the case of the larger relative. There are some half dozen records for Long Island, N. Y. (Braislin), and one for Buffalo, N. Y. (Eaton). The species is recorded from Stratford, Hartford, Saybrook, and Groton Long Point, Conn. (Merriam); Nantucket, Mass., March, 1882 (Purdie); St. Albans, Vt., October, 1890 (Howe); Grand Manan, N. B. (Boardman); near Halifax, N. S., 1868, and Windsor, N. S., 1872 (Downs); in each of the counties in Ohio along Lake Erie (Jones); Dunnville and Long Point, Ontario (McIlwraith); Keokuk, Iowa (Praeger); Des Moines, Iowa (Keyes); Lake Koskonong, Wis., August, 1886 (Skavlem); Topeka, Kans., August 15, 1872 (Prentice); Fremont, Nebr., September 4, 1893 (Trostler); near Laramie, Wyo., early May, 1902 (Knight); Buffalo, Wyo., about April 11, 1904 (Felger); near Calgary, Alberta, May 11, 1901 (Dippie); Burrard Inlet, B. C., May, 1879 (Fannin).

It will be noticed that many of these are spring records, and they differ from those of the larger egret in representing the wandering of adult birds rather than of newly fledged young. The same thing is shown still more strongly by the Colorado records. More than 50 instances of the occurrence of the bird in the State are on record, showing that it is a regular visitant, and nearly half are in the spring—earliest April 15, 1906, near Nucla (Warren)—and the remainder at intervals through the season to October 4, 1897, the latest at Pueblo (Doertenbach). Yet the bird is not known to nest in Colorado and probably does not breed anywhere within 500 miles of the State. The same conditions occur in California, where at Stockton the bird was found common in 1878 from March 6 to November 20 (Belding), yet did not nest. Thus it seems that in the case of the snowy egret many adult birds went north at the time of the spring migration far beyond the regular breeding range of the species and spent the summer there as nonbreeders. This species is an exception to the general rule that "all birds breed at the northern limit of their range." This remaining of nonbreeders throughout the summer north of their breeding range is just the opposite of what happens among the shore birds, many of which remain as nonbreeders all summer far south of the breeding range.

The snowy egret produces plumes selling for more than their weight in gold, and consequently the birds have been persistently persecuted until in the United States they have reached the verge of extinction. A few small colonies still remain, however, to serve as centers of distribution now that better laws and a better public sentiment in favor of bird protection bid fair to allow this beautiful species a chance to reoccupy its former range. Within late years the birds have been known to breed in Florida, near Cape Sable, in 1903 (Bent); Charleston, S. C., 1910 (Wayne); on the Audubon bird reservation at the mouth of the Mississippi River, La., 1908 (Kopman); the species probably nested in 1909 near Beaufort, N. C., where they were seen June 23 (Bowdish); and a few nested in 1911 near Orton, Brunswick County, N. C. (Brimley). The largest colony now existing in the United States is on the great bird refuge of Avery Island, La., where in 1910 it was estimated that fully 2,000 pairs were nesting (Ward). Some other late records of migrants or wanderers have been made near Deming, N. Mex., November 5, 1906 (Munson); Sapillo Creek, N. Mex., October 21, 1908 (Bergtold); Delair, N. J., July 16, 1904 (Miller); and San Quintin Bay, Lower California, April, 1910 (Howell).

Winter range.—The snowy egret remained throughout the winter in full numbers in southern Florida, but from central Florida northward most of the birds retired during the cold season. A few were found in winter at Anclote Keys, Fla. (Scott); Gainesville, Fla.

(Chapman); and at St. Marys, Ga. (Helme); while in Audubon's time a few wintered as far north as Charleston, S. C. The birds winter rarely on the coast of Louisiana (Beyer), but, even in the early days when they were abundant, only a few remained through the winter near Galveston, Tex. (Audubon), or even as far south as Brownsville, Tex. (Merrill). In western Mexico the snowy egret is resident as far north as it breeds, and seems to be nonmigratory throughout all of its range in Central and South America.

Spring migration.—The northward movement began in early March: Cumberland, Ga., March 7, 1902 (Helme); Warrington, Fla., March 22, 1885 (Stone); Frogmore, S. C., average date of arrival for five years March 23, earliest March 22, 1889 (Hoxie); southern New Jersey, arrived in early May (Audubon); Rodney, Miss., April 18, 1887, April 13, 1888 (Mabbett).

The nesting season is exceedingly variable in different parts of the extensive breeding range; in the extreme south, at Buenos Aires, Argentina, eggs are laid in November (Gibson); Man-o'-war Cay, British Honduras, young nearly grown May 8, 1862 (Salvin); Cuba, nests from June to October (Gundlach); Tarpon Springs, Fla., eggs August 26, 1886 (Scott); Charlotte Harbor, Fla., May 6, 1886 (Scott); Kissimmee Lake, Fla., April 19, 1908 (Nicholson); Charleston, S. C., April 27, 1910 (Wayne); Cape May, N. J., May 19, 1812 (Wilson); Louisiana, eggs April 10 to June (Baird, Brewer, and Ridgway); Brownsville, Tex., young just hatched May 15, 1877 (Sennett); San Jose Island, Lower California, eggs June 19–24, 1908 (Thayer).

Fall migration.—The presence of nonbreeding birds throughout the summer north of the normal breeding range obscures the records of the northward migration of the young birds in the fall, but this seems to have taken place in July, as in the other species of herons, but never to have been on a large scale. The Long Island records occur from July 1 to August 4 (Braislin); latest in Maryland at Marlboro, August 25, 1893 (Kirkwood); Frogmore, S. C., October 4, 1886 (Hoxie); Canadian River, Okla., still common September 3 to 5, 1820 (Long).

Reddish Egret. *Dichromanassa rufescens* (Gmelin).

The range of the reddish egret extends from the Gulf States to Mexico, the Bahamas, and the Greater Antilles.

This bird is more restricted than most of the herons in its breeding range, which includes Florida north to Pelican Island (Bryant); and lower Suwanee River (Brewster and Chapman); the coast of Louisiana (Beyer); Corpus Christi, Tex. (Sennett); and Browns-

ville, Tex. (Merrill). It breeds somewhat commonly in the Bahamas from Great Bahama (Cory) and Abaco (Ridgway) on the north to Caicos (Cory) on the south; is rare in Cuba (Gundlach), and is recorded from Jamaica (March) and Haiti (Cory). It breeds at San Jose Island, Lower California (Brown); near San Blas, Tepic (Nelson); and on the coast and islands of Yucatan (Salvin, Lawrence, and Nelson). It has been taken at Chiapam, Guatemala (Salvin); and at Tehautepec, Oaxaca (Sumichrast); and, as the species is largely nonmigratory, probably it breeds at or near both these localities.

A few instances have been noted of the wandering of the reddish egret north of its breeding range. Several were seen in August, 1875,

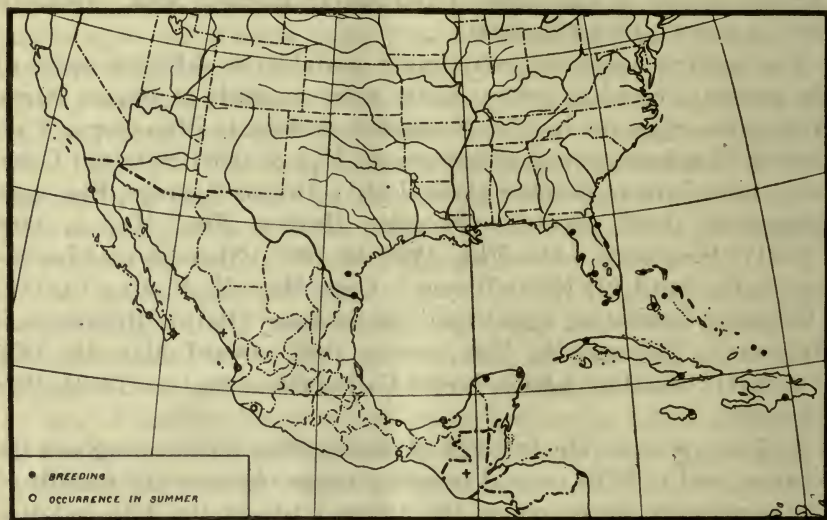


FIG. 16.—Reddish egret (*Dichromanassa rufescens*).

near Cairo, Ill. (Nelson); one was taken near Colorado Springs, Colo. (Aiken); and one near Golden, Colo. (Berthoud); and several were seen at San Quintin, Lower California (Anthony).

It is partially migratory along the north limit of the breeding range, and few, if any, remain in Louisiana through the whole of the winter, but the species does winter in southern Florida (Scott) and in Mexico as far north as Mazatlan, Sinaloa (Lawrence), and La Paz, Lower California (Belding).

Eggs were found near Corpus Christi, Tex., March 24, 1878 (Sennett); young in the nest, May 3, 1890, at Captive Pass, Fla. (Jamison); and young on the wing, April 15, 1901, Cozumel Island, Yucatan (Nelson). Gundlach says that in Cuba it nests from July to October.

Louisiana Heron. *Hydranassa tricolor ruficollis* (Gosse).

The Louisiana heron, as a whole, ranges from the Gulf States and Mexico south to northern South America. It has been separated into two subspecies, of which the northern, *ruficollis*, extends north to North Carolina, Texas, and central Mexico, and south throughout the Bahamas, the Greater Antilles, and Middle America to Ecuador and Venezuela.

The principal breeding range of the Louisiana heron in the United States is found in Florida and along the Gulf coast to Texas. On the Atlantic coast it is common north to Charleston, S. C. (Wayne), and in Audubon's time it was considered abundant on the coast of

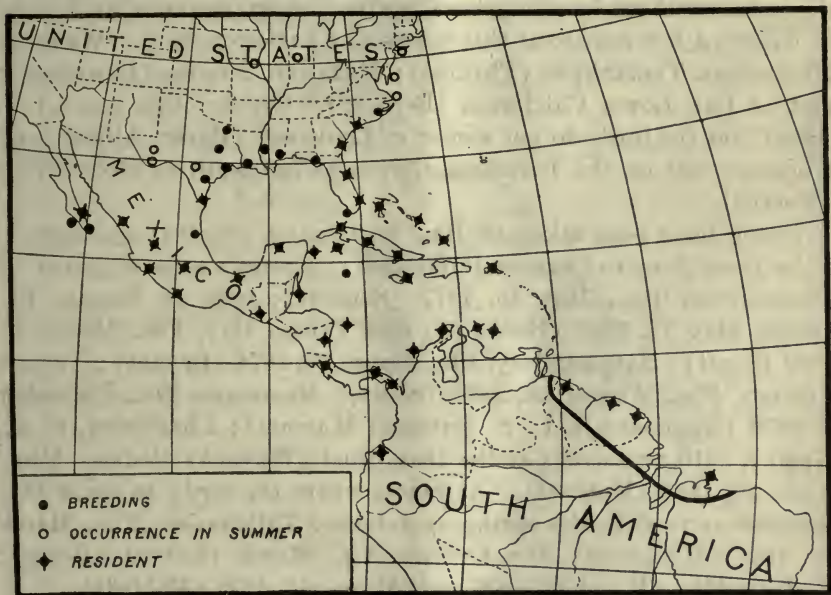


FIG. 17.—Louisiana heron (*Hydranassa tricolor ruficollis*).

North Carolina, where it was still not uncommon near Beaufort in 1898 (Pearson), and nested commonly near Orton, Brunswick County, in 1911 (Brimley). This seems to be the northern limit of the breeding range.

In the Mississippi Valley it has nested north to Rodney, Miss. (Mabbett); and Texarkana, Tex. (Oberholser). It seldom wanders far north of its breeding ground, but a few have been noted at Cobb Island, Va. (Ridgway); Patchogue, N. Y., the summer of 1836 (Giraud); Sand Ridge, Clark County, Mo., April 13, 1890 (Currier); near Hanna, Ind., June 26, 1876 (Nelson); Stockton, Tex. (Dresser); and Terlingua, Tex. (Oberholser).

The Louisiana heron breeds along the whole eastern coast of Mexico and north on the west coast to Mazatlan, Sinaloa (Lawrence); La Paz, Lower California (Belding); and Santa Margarita Island, Lower California (Bryant). It breeds south throughout Central America to the Rio Sabana, Panama (Salvadori and Festa); Don Diego, Santa Marta, Colombia (Allen); the islands of Aruba and Margarita, off the coast of Venezuela (Cory); and to Vaqueria in northwestern Ecuador (Hellmayr). It is one of the commoner herons in the Bahamas north to Berry Island (Cory); abundant in Cuba (Gundlach); abundant in Jamaica (Field); and in Porto Rico (Gundlach).

The Louisiana heron is only partially migratory. While many of the most northern breeding birds retire a short distance southward in winter, a few remain at this season at Charleston, S. C. (Wayne); Matamoras, Tamaulipas (Phillips); Mazatlan, Sinaloa (Lawrence); and La Paz, Lower California (Belding). On the other hand, it is stated that the birds do not winter in Louisiana (Beyer, Allison, and Kopman) nor on the Texas coast, even as far south as Brownsville (Merrill).

Young have been taken in June in Jamaica (Scott); and eggs in Cuba from June to October (Gundlach); young a quarter grown at Brownsville, Tex., May 15, 1877 (Sennett); eggs at Nassau, Bahamas, May 17, 1902 (Bonhote); Old Tampa Bay, Fla., March 15, 1880 (Scott); Sarasota Bay, Fla., March 30, 1874 (Bryant); Tarpon Springs, Fla., August 26, 1886 (Scott); Micanopy, Fla., December 8, 1859 (specimens in U. S. National Museum); Charleston, S. C., April 7, 1910, two weeks earlier than usual (Wayne); Rodney, Miss., April 16, 1888 (Mabbett). At places where the birds do not winter the first arrived in the spring as follows: Tallahassee, Fla., March 25, 1901 (Williams); New Orleans, La., March 11, 1894 (Beyer); Rodney, Miss., March 23, 1889, and March 21, 1890 (Mabbett).

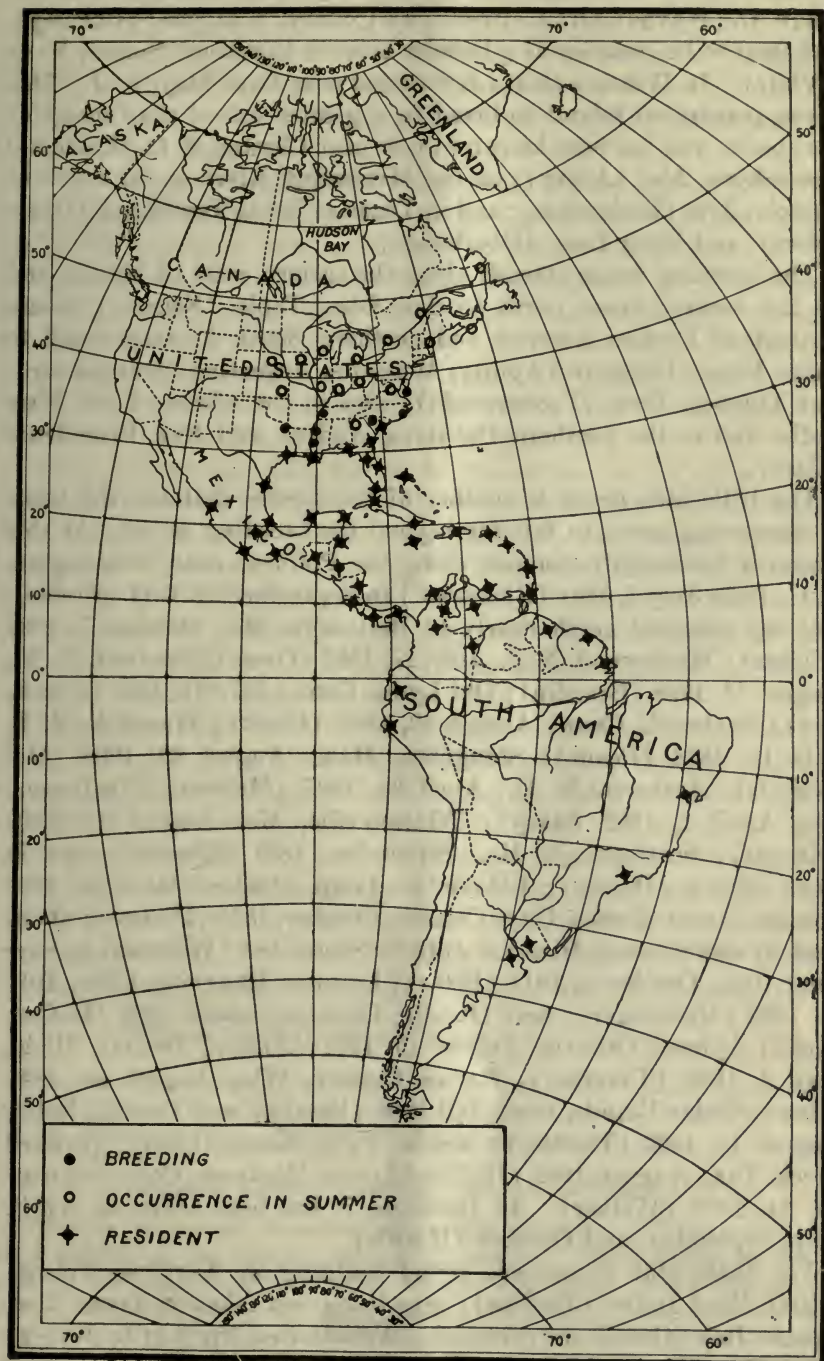
Demi-Egret. *Hydranassa tricolor tricolor* (Muller).

The typical form, *tricolor*, is restricted to the Guianas and Brazil, occurring in the latter country south to Cajutuba and Garape (Pelzeln).

Little Blue Heron. *Florida caerulea* (Linnaeus).

The little blue heron is common throughout tropical America, breeding north to South Carolina (formerly to New Jersey), Arkansas, and central Mexico, and south to Argentina and Peru; has wandered to Nova Scotia, Wisconsin, and Nebraska.

The little blue heron is one of the commoner herons now found in the southern United States, and is most common in Florida and in the immediate vicinity of the Gulf coast, thence to Texas. Along

FIG. 18.—Little blue heron (*Florida caerules*).

the Atlantic coast the bird breeds commonly as far north as Charleston, S. C. (Wayne), Orton, Brunswick County, N. C., 1911 (Brimley), and used to be common as a breeder even to Currituck Sound, N. C. (White). In Wilson's time a few nested near Cape May, N. J. This heron penetrated inland to breed to a greater extent than many of the species and has been known to nest near Chester, S. C. (Loomis); Greensboro, Ala. (Avery); on the Mississippi River as far north as Osceola, Ark. (Richardson); and in Texas as far as Texarkana (Oberholser), and Long Lake (Oberholser).

The breeding range extends along the eastern coast of Mexico and on the western coast north to San Blas, Tepic (Nelson); thence throughout Central America and northern South America south to Santa Elena, Uruguay (Aplin); Mercedes, Argentina (Burmeister); and Tumbes, Peru (Taczanowski); also in the whole of the West Indies and in the northern Bahamas, Andros, and New Providence (Cory).

The little blue heron is another of the species that has the habit of wandering north in fall far beyond the breeding range. At this season it is tolerably common along the Potomac near Washington, D. C., from July 7, 1894 (Richmond) to September 24, 1911 (Preble), and has occurred north nearly to Baltimore, Md., October 7, 1892 (Fisher); Maplewood, N. J., July 27, 1897 (Owen); Seaford, N. Y., August 13, 1902 (Braislin); Old Lyme, Conn., July 21, 1899 (Brockway); Saybrook, Conn., August 12, 1881 (Clark); Warwick, R. I., July 13, 1878 (Deane); Stoughton, Mass., August 22, 1908 (McKechnie); Amherst, N. H., April 28, 1897 (Melzer); Vinalhaven, Me., April 1, 1902 (Arey); Whitneyville, Me., August 16, 1906 (Knight); Scarborough, Me., September, 1881 (Brown); once in Nova Scotia (Downs); L'Anse au Loup, Quebec, May 23, 1900 (Bangs); near Quebec City, Canada, October, 1881 (Dionne); abundant in southeastern Missouri July to September (Widmann); Seymour, Ind., October 8, 1911 (Peter); Loramie Reservoir, Ohio, July 16, 1909 (Henninger); near Oberlin, Ohio, one about 1882 (McCormick); Aylmer, Ontario, August 15, 1901 (Ames); Detroit, Mich., May 2, 1882 (Taverner); Racine County, Wis., August 28, 1848 (Hoy); Cedar Rapids, Iowa, fall 1903 (Berry); near Omaha, Nebr., August 15, 1903 (Trostler); Neosho Falls, Kans. (Goss); Howard Creek, Tex., August, 1902 (Hollister); and Montrose, Colo., September 14, 1910 (Walker). In Bermuda it has been taken in April, May, September, and October (Hurdis).

The little blue heron was found building in April on Tobago Island, West Indies (Jardine); eggs have been taken in Porto Rico, May to July (Gundlach); Grenada, West Indies, April 14 to June 21

(Oates); Jamaica, June 3 to July 8, 1890 (Field); Cuba, May to July (Gundlach); Alachua County, Fla., April 8, 1890 (Pearson); Tarpon Springs, Fla., August 26, 1886 (Scott); Charleston, S. C., April 7, 1910, much earlier than usual (Wayne); Avery Island, La., May 4, 1895 (Knight); Corpus Christi, Tex., June 12, 1884 (specimens in U. S. National Museum).

Winter range.—This species remains in winter throughout the larger part of its coastal breeding range in the United States, staying north regularly and commonly as far as Charleston, S. C. (Wayne), and a few on Currituck Sound (McAtee). It is not rare in winter on the coasts of Louisiana and Texas (McAtee), though the larger part of the breeding birds in all the above-mentioned places retire farther south for the winter. The winter range on the Pacific coast of Mexico includes the district north to Ocotlan, Jalisco (Goldman), and to Mazatlan, Sinaloa (Lawrence).

Spring migration.—The arrival of the species in the spring was noted at Whitfield, Fla., March 21, 1903 (Worthington); Chipley, Fla., March 12, 1903 (Pleas); Cumberland, Ga., March 8, 1902 (Helme); Frogmore, S. C., average of four years March 31, earliest March 22, 1886 (Hoxie); New Orleans, La., average March 13, earliest March 11, 1894 (Beyer); Bay St. Louis, Miss., March 13, 1902 (Allison); St. Louis, Mo., April 30, 1880 (Hurter); and Bicknell, Ind., April 18, 1896 (Chansler).

The last two dates, taken in connection with several others already given, show that a few little blue herons migrate or wander north in the spring beyond the normal breeding range, but there are no dates to indicate that such birds remain the rest of the summer in the north as nonbreeders, and probably they soon return southward.

The birds of the southern part of the range have been separated as the subspecies *cærulescens* (Latham), which includes all of South America and parts of the Antilles and Central America. The dividing line between these two forms is not yet definitely known.

[Zeledon Boatbill. *Cochlearius zeledoni* (Ridgway).]

The Zeledon boatbill occupies nearly the whole of Mexico and Central America from Sinaloa (Mazatlan), Tamaulipas (Alta Mira), and Yucatan (Cozumel Island), south and east to Porto Bello, Panama (Goldman).]

[Pileated Heron. *Pilherodius pileatus* (Boddaert).]

This heron is a South American species that was once taken 50 years ago along the line of the Panama Railroad (Lawrence). Since it has not been noted by the many collectors who have visited Panama in the last few years, it is probably now extinct in that country. The range in South America extends south to Peru (Pebas, Santa Cruz, and Nauta) and to Sao Paulo, Brazil.]

Green Heron. *Butorides virescens virescens* (Linnaeus).

Range.—The green herons as a whole include several forms which range over most of the United States, all of Mexico, Central America, and the West Indies, and in South America are found in northeastern Colombia, northern Venezuela, and northeastern Brazil.

Breeding range.—The typical form, true *virescens*, breeds north to St. John, New Brunswick (Chamberlain); Montreal, Canada (Wintle); Loughboro Lake, Ontario (Clarke); Guelph, Ontario (Klugh); Kelley Brook, Wis. (Shoenebeck); Minneapolis, Minn. (Grant); and Vermilion, S. Dak. (Agersborg). In the west the species seems to be absent as a breeder from the western part of the plains and the whole of the middle and northern Rocky Mountains. The breeding range extends westward to about the ninety-ninth meridian, except in the Rio Grande Valley, up which the species ranges to the Rio Conchas (J. W. Audubon). The birds have wandered north in summer to Prospect, Nova Scotia (Downs), and on April 15, 1881, after a storm, they were actually common at Westport, Nova Scotia (Chamberlain). They have also been seen north to Ottawa, Ontario (White); Neebish Island, Mich. (Boies); Fort Sisseton, S. Dak (McChesney); and west to Loveland, Colo., July 23, 1895 (Preble); Rinconada, N. Mex. (Surber); and Pecos City, Tex. (Donald).

The breeding range extends south to include the whole of Florida and the Gulf States, eastern Texas, the eastern coast of Mexico, the whole of southern Mexico, Yucatan, and south to Duenas, Guatemala (Salvin and Sclater), and east to Ceiba, Honduras (Bangs). The species breeds also on the west coast of Mexico north to Tepic (Nelson and Goldman).

Winter range.—The green heron winters throughout its range in Mexico and Central America, but no migrating birds from the United States seem to pass any farther south in winter than the region inhabited by the species in summer. Not even in Cuba or the Bahamas has the form of the green heron breeding in Florida and the eastern United States been as yet detected. Since the species is very rare in winter in southern Florida and southern Texas and is absent at this season from the rest of the Gulf States, it follows that nearly all of the tens of thousands of green herons that breed in the eastern United States must reach a winter home in Yucatan and southward by a direct flight across the Gulf of Mexico. The species has been noted in winter north to Gainesville, Fla. (Chapman); Sarasota Bay, Fla. (Bryant); Capers Island, S. C. (Wayne); and Brownsville, Tex. (Merrill).

Spring migration.

Place.	Number of years' records.	Average date of spring arrival.	Earliest date of spring arrival.
Central Florida.....	5	Mar. 17	Feb. 8, 1905
St. Marys, Ga. (near).....	3	Mar. 23	Feb. 8, 1902
College Park, Ga.....			Mar. 23, 1906
Frogmore, S. C.....	6	Mar. 26	Mar. 21, 1889
Raleigh, N. C.....	12	Apr. 7	Mar. 29, 1893
Weaverville, N. C.....	4	Apr. 20	Apr. 10, 1891
White Sulphur Springs, W. Va.....	6	Apr. 23	Apr. 14, 1892
Washington, D. C.....	11	Apr. 19	Apr. 9, 1905
Waynesboro, Pa.....	5	Apr. 21	Apr. 17, 1896
Philadelphia, Pa. (near).....	8	Apr. 24	Apr. 16, 1884
Renovo, Pa.....	10	May 7	Apr. 24, 1899
Morristown, N. J.....	4	Apr. 25	Apr. 18, 1909
New Providence, N. J.....	10	Apr. 30	Apr. 23, 1893
Ithaca, N. Y.....	2	Apr. 20	Apr. 18, 1906
New York, N. Y. (near).....	9	May 4	Apr. 24, 1890
Branc hport, N. Y.....	10	May 1	Apr. 21, 1900
Ballston Spa, N. Y.....	4	May 8	May 7, 1890
New Haven, Conn. (near).....	5	Apr. 29	Apr. 27, 1886
Hartford, Conn. (near).....	5	Apr. 28	Apr. 26, 1896
Providence, R. I.....	9	May 5	Apr. 25, 1899
Fitchburg, Mass.....	6	May 7	May 5, 1907
Needham, Mass.....			Apr. 9, 1905
Randolph, Vt.....			May 7, 1887
Portland, Me.....			Apr. 25, 1905
Montreal, Canada.....			Apr. 30, 1895
New Orleans, La.....			Mar. 21, 1894
Rodney, Miss. (near).....	3	Apr. 10	Mar. 26, 1889
Athens, Tenn.....			Mar. 30, 1904
Lexington, Ky.....	5	Apr. 20	Apr. 11, 1904
Monter, Mo.....	3	Apr. 23	Apr. 10, 1905
Iberia, Mo.....	4	Apr. 30	Apr. 27, 1905
St. Louis, Mo.....	3	May 2	Apr. 17, 1886
Bloomington, Ind.....	7	Apr. 19	Apr. 10, 1903
Terre Haute, Ind.....	4	Apr. 20	Apr. 13, 1889
Greencastle, Ind.....	5	Apr. 21	Apr. 16, 1894
Brookville, Ind.....	6	Apr. 21	Apr. 17, 1888
Fort Wayne, Ind.....	5	Apr. 24	Apr. 22, 1909
Waterloo, Ind. (near).....	9	May 2	Apr. 13, 1905
Delaware, Ohio.....	4	Apr. 25	Apr. 21, 1906
Youngstown, Ohio.....	5	Apr. 25	Apr. 21, 1906
Oberlin, Ohio.....	14	Apr. 26	Apr. 14, 1899
Vicksburg, Mich.....	3	May 6	Apr. 25, 1908
Guelph, Ontario (near).....	5	May 14	May 11, 1900
Keokuk, Iowa.....	10	May 1	Apr. 21, 1893
Iowa City, Iowa.....	8	May 1	Apr. 24, 1891
Laporte, Iowa.....	5	Apr. 23	Apr. 24, 1884
Chicago, Ill.....	12	Apr. 28	Apr. 11, 1908
Delavan, Wis.....			Apr. 20, 1896
Madison, Wis. (near).....	7	May 5	Apr. 26, 1901
Lanesboro, Minn.....	5	May 4	Apr. 23, 1885
Beaumont, Tex.....			Apr. 4, 1887
Kerrville, Tex.....	7	Apr. 20	Apr. 7, 1906
Manhattan, Kans.....	5	Apr. 25	Apr. 16, 1883
Onaga, Kans.....	8	May 7	Apr. 21, 1904
Southeastern Nebraska.....	8	Apr. 30	Apr. 15, 1899

Eggs have been found at Manatee River, British Honduras, April 21, 1906 (Thayer); Sarasota Bay, Fla., April 18 to June 1 (Bryant); near Orange Hammock, Fla., March 23, 1895, well incubated (Palmer); Frogmore, S. C., April 13, 1870, and June 11, 1886 (Hoxie); Chatham County, N. C., April 20, 1886 (Brooks); Baltimore, Md., April 22, 1881, to June 12, 1894 (Kirkwood); Holland Patent, N. Y., May 16, 1890 (Williams); Canaan, Conn., May 15, 1886 (Tobey); Sunapee, N. H., June 16, 1886 (Bowles); Avery Island, La., April 9, 1893 (specimens in U. S. National Museum); Bernadotte, Ill., May 5, 1891 (Knight); Bloomington, Ind., May 11, 1903 (McAtee);

Sedan, Ind., May 14, 1897 (Hine); Philo, Ill., May 21, 1905 (Hess); Polo, Ill., May 25, 1884 (Kline); Seneca County, Ohio, May 10, 1904 (Henninger); Vicksburg, Mich., June 1, 1904 (Rapp); Charleston Lake, Ontario, June 14, 1899 (Clarke); Davenport, Iowa, May 7, 1892 (Wilson); Brownsville, Tex., May 2, 1877 (specimens in U. S. National Museum); Manhattan, Kans., May 13, 1884 (Lantz); Peru, Nebr., June 2, 1882 (Taylor and Van Vleet).

Fall migration.

Place.	Number of years' records.	Average date of the last one seen.	Latest date of the last one seen.
Montreal, Canada.....	2	Sept. 1	Sept. 2, 1897
Pittsfield, Me.....	3	Sept. 21	Oct. 2, 1898
Southwestern Ontario.....	3	Sept. 18	Sept. 22, 1909
Southern Michigan.....	8	Sept. 19	Oct. 4, 1903
Madison, Wis.....			Sept. 14, 1910
Lanesboro, Minn.....	4	Sept. 13	Sept. 25, 1891
Dunbar, Nebr.....			Sept. 24, 1904
Onaga, Kans.....	8	Sept. 16	Oct. 5, 1909
Bonham, Tex.....			Sept. 20, 1889
Southern Iowa.....	4	Sept. 24	Oct. 17, 1897
Chicago, Ill.....			Sept. 22, 1907
Greensburg, Ind.....			Oct. 7, 1894
Waterloo, Ind. (near).....	4	Sept. 19	Sept. 30, 1905
Waverly, Ohio.....			Oct. 1, 1898
Oberlin, Ohio.....			Nov. 13, 1897
Athens, Tenn.....			Oct. 10, 1902
Durham, N. H.....			Oct. 13, 1900
North Truro, Mass.....			Oct. 5, 1889
Providence, R. I.....	9	Sept. 15	Sept. 29, 1897
Hartford, Conn. (near).....	5	Sept. 11	Oct. 1, 1894
Central New York.....	12	Sept. 19	Oct. 2, 1902
Morristown, N. J.....	4	Sept. 17	Oct. 2, 1905
New Providence, N. J.....	4	Sept. 17	Oct. 10, 1894
Beaver, Pa.....	3	Sept. 21	Sept. 25, 1907
Renovo, Pa.....	6	Sept. 21	Oct. 14, 1909
Washington, D. C.....	5	Aug. 27	Oct. 2, 1910
Weaverville, N. C.....			Oct. 10, 1891
Frogmore, S. C.....			Oct. 4, 1886
St. Marys, Ga.....			Oct. 24, 1905
Orlando, Fla.....			Nov. 18, 1885

Anthony Green Heron. *Butorides virescens anthonyi* (Mearns).

The breeding range of the Anthony green heron extends north to Ukiah, Cal. (McGregor), and to Colusa, Cal. (Hollister). The species has wandered north to Yreka, Cal., August 20, 1883 (Townsend), and to Fort Klamath, Oreg., May 4, 1887 (Merrill). It breeds south as far as the Coronados Islands, Lower California (Anthony), Yuma, Ariz. (Coues), and Tombstone, Ariz. (Willard), and northeast to Big Sandy, Ariz. (Stephens), and Camp Verde, Ariz. (Mearns).

It winters in Mexico from Ocotlan, Jalisco (Nelson and Goldman), and the Valley of Mexico (specimen in U. S. National Museum) south to Zamora, Michoacan (Nelson and Goldman), and to Tehuantepec, Oaxaca (Lawrence).

In migration it occurs at San Jose del Cabo, Lower California (Brewster), and Victoria, Tamaulipas (Sennett). A specimen taken November 27, 1896, at San Jose, Costa Rica, is undistinguishable from the Mexican bird.

In spring migration the earliest appearance at Tombstone, Ariz., was on April 22, 1909 (Willard); Sebastopol, Cal., March 12, 1885 (Belding); Stockton, Cal., average April 9, earliest April 4, 1885 (Belding). Eggs are in the U. S. National Museum that were taken May 24, 1890, at Silver Lake, near Tucson, Ariz., and eggs were taken on the Sespe River, Ventura County, Cal., May 12, 1910 (Peyton).

Frazar Green Heron. *Butorides virescens frazari* (Brewster).

The Frazar green heron is restricted to the southern end of Lower California, where it is resident at La Paz, in the region around Magdalena Bay and north to San Ignacio (Nelson and Goldman). Eggs were taken near La Paz May 8 to 26, 1910 (Thayer).

Green Heron. *Butorides virescens* (subsp.).

The two forms of the green heron *virescens* and *anthonyi* are the only ones that occur in the United States. These two forms include the migratory green herons, which have a wide range and perform migrations extending often more than a thousand miles. In southern Central America, northern South America, and throughout the whole of the West Indies the green herons seem to be strictly resident, and as a consequence they have become modified into a large number of local forms or subspecies.

Mr. H. C. Oberholser has recently made an extended study of the green herons, and his conclusions as to the ranges of the various forms are given below:

Chihuahua Green Heron, *Butorides virescens eremonomus* Oberholser. Chihuahua and Durango, Mexico, in summer; south to Michoacan, Mexico, in winter.

Nicaragua Green Heron, *Butorides virescens mesatus* Oberholser. Western Nicaragua.

Panama Green Heron, *Butorides virescens hypernoteus* Oberholser. Costa Rica, Panama, and northern South America, south to Medellin, Colombia, and Para, Brazil.

Swan Island Green Heron, *Butorides virescens saturatus* Ridgway. Swan Island, Caribbean Sea.

San Miguel Green Heron, *Butorides virescens margaritophilus* Oberholser. San Miguel Island, Panama.

Bahama Green Heron, *Butorides virescens bahamensis* (Brewster). The Bahama Islands.

Cuba Green Heron, *Butorides virescens cubanus* Oberholser. The Greater Antilles and east in the Lesser Antilles to Guadeloupe Island.

St. Christopher Green Heron, *Butorides virescens christophorensis* Oberholser. St. Christopher Island, Lesser Antilles.

Dominica Green Heron, *Butorides virescens dominicanus* Oberholser. Dominica Island, Lesser Antilles.

Martinique Green Heron, *Butorides virescens maculatus* (Boddaert). Martinique Island, Lesser Antilles.

St. Lucia Green Heron, *Butorides virescens lucianus* Oberholser. St. Lucia Island, Lesser Antilles.

Barbados Green Heron, *Butorides virescens barbadensis* Oberholser. Barbados Island, Lesser Antilles.

Grenada Green Heron, *Butorides virescens grenadensis* Oberholser. Grenada Island to St. Vincent Island, Lesser Antilles.

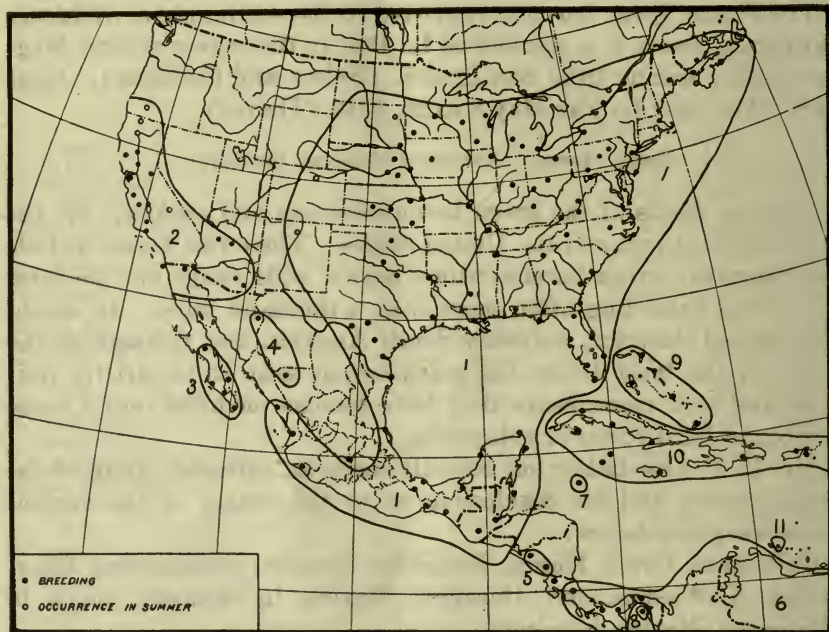


FIG. 19.—Green heron (*Butorides virescens*). Subspecies: 1, *virescens*; 2, *anthonyi*; 3, *frazari*; 4, *eremonomus*; 5, *mesatus*; 6, *hypernotus*; 7, *saturatus*; 8, *margaritophilus*; 9, *bahamensis*; 10, *cubanus*; 11, *curacensis*; seven other subspecies are on as many islands of the Lesser Antilles.

Tobago Green Heron, *Butorides virescens tobagensis* Oberholser. Tobago Island, Lesser Antilles.

Curaçao Green Heron, *Butorides virescens curacensis* Oberholser. Curaçao Island, off the coast of Venezuela.

[Lembeye Green Heron. *Butorides brunescens* (Lembeye).

Resident in Cuba and the Isle of Pines.]

[Striated Heron. *Butorides striata* (Linnæus).

A resident species occurring commonly in northern South America south to Peru and Argentina. The only record north of South America is that of a specimen taken May, 1904, on the savanna of Panama (Thayer and Bangs).]

Black-crowned Night Heron. *Nycticorax nycticorax naevius* (Boddaert).

Range.—The black-crowned night heron, including all of its various forms, is one of the most widely distributed of birds. In the

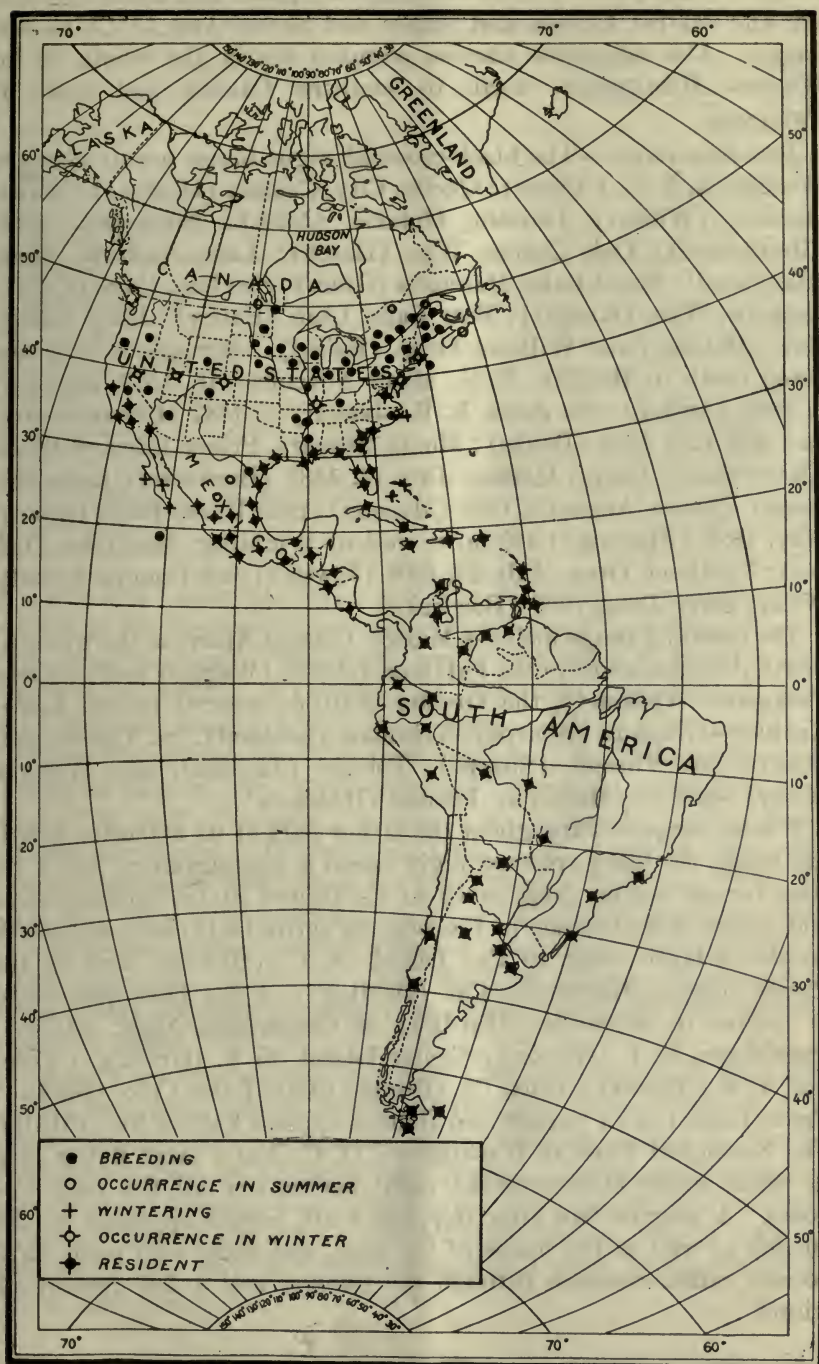


FIG. 20.—Black-crowned night heron (*Nycticorax nycticorax naevius*).

Eastern Hemisphere it occurs throughout Africa and north to southern and central Europe and thence east across Asia to China and Japan. The subspecies *naevius* occupies nearly the whole of the Western Hemisphere, north to southern Canada and south to Patagonia.

Breeding range.—The black-crowned night heron breeds north to Woodstock, N. B. (Adney); Quebec City, Canada (Dionne); Ottawa, Ontario (White); Toronto, Ontario (Nash); Rochester, Mich. (Bretherton); Oak Center, Wis. (Hatch); Lake Andrew, Minn. (Skoglund); Shoal Lake, Manitoba (Gunn); Sterling, Colo. (Cary); Laramie, Wyo. (Knight); Bear Lake, Utah (Bailey); Ruby Valley, Nev. (Bailey); and Willows, Oreg. (Bailey). Stragglers have been noted north to Halifax, N. S., about November 18, 1888, and July 4, 1889 (Austen); St. John, N. B., January 5, 1887 (Chamberlain), and April 20, 1888 (Banks); Mount Stewart, Prince Edward Island (MacSwain); Gaspe, Quebec, July 14, 1881 (Brewster); Lake Mistassini, Quebec, August 6, 1885 (Macoun); near Burks Falls, Ontario, May, 1899 (Fleming); 140 miles west of Winnipeg, Manitoba (Talbot); Portland, Oreg., July 29, 1908 (Jewett); and Douglas County, Wash., early June, 1906 (Bowles).

The breeding range includes Mexico, Central America, the whole of South America south to the Falkland Islands (Wagler) and southern Patagonia (Oustelet), the Greater Antilles, several of the Lesser Antilles—Granada (Sharpe), Trinidad (Leotaud), St. Christopher (Cory), St. Vincent (Sharpe), Tobago (Jardine), and Antigua (Cory)—and the Hawaiian Islands (Henshaw).

Winter range.—Throughout the larger part of its extensive breeding range, the black-crowned night heron is nonmigratory, but it retires for the winter from much of its United States summer home and occurs at that season in Florida, the entire Gulf coast, and north on the Atlantic coast to Pea Island, N. C. (Bishop), and on the Pacific slope to Marysville, Cal. (Belding). A few have been noted in winter in Bermuda (Hurdis); at Cambridge, Mass. (Allen); Providence, R. I. (Billson); Shelter Island, N. Y. (Griffing); Trenton, N. J. (Abbott); Anna, Ill. (Butler); Barr Lake, Colo. (Smith); Provo Lake, Utah (Yarrow and Henshaw); and Fallon, Nev. (Mills). The Zoological Park at Washington, D. C., has a large flying cage in which many black-crowned night herons live all the year outdoors. A year or two after this was built, herons appeared on the outside as well as the inside of the cage, and these wild birds have become rather common through the summer and a few remain all winter.

Spring migration.

Place.	Number of years' records.	Average date of spring arrival.	Earliest date of spring arrival.
Philadelphia, Pa. (near).....	9	Apr. 22	Feb. 15, 1902
Morristown, N. J.....	3	Apr. 22	Apr. 19, 1885
New Providence, N. J.....	3	Apr. 10	Mar. 23, 1884
New York, N. Y. (near).....	8	Apr. 16	Mar. 4, 1895
Hartford, Conn.....	7	Apr. 9	Mar. 28, 1902
Providence, R. I.....	6	Apr. 6	Mar. 17, 1907
Southeastern Massachusetts.....	9	Apr. 24	Mar. 28, 1893
Monadnock, N. H.....			Apr. 11, 1902
Portland, Me.....			Apr. 18, 1906
Quebec City, Canada.....	3	Apr. 14	Apr. 10, 1905
Rodney, Miss.....	2	Mar. 24	Mar. 22, 1884
St. Louis, Mo.....	3	Apr. 22	Apr. 20, 1886
Urbana, Ill.....	2	Mar. 31	Mar. 26, 1904
Rockford, Ill.....			Apr. 5, 1890
Chicago, Ill.....	9	Apr. 23	Apr. 8, 1894
Sandusky, Ohio.....	3	Apr. 16	Apr. 14, 1902
Ottawa, Ontario.....	2	Apr. 24	Apr. 18, 1894
Grinnell, Iowa.....	3	Apr. 17	Apr. 8, 1887
Forest City, Iowa.....			Apr. 3, 1897
Heron Lake, Minn.....	9	Apr. 12	Apr. 6, 1890
East-central Kansas.....	5	Apr. 19	Apr. 15, 1907
Eastern Nebraska.....	5	Apr. 22	Apr. 2, 1904
Larimore, N. Dak.....			May 1, 1893
Denver, Colo. (near).....	5	Apr. 25	Apr. 21, 1906

As would be expected from a species with such an extended range, the eggs are deposited at widely different times in different parts of the breeding range. While eggs are most commonly found in Chile during the months of October and November (Germain), in Cuba, the eggs are usually deposited in April and May (Gundlach); San Mateo, Fla., March 29, 1882 (specimens in U. S. National Museum); Alachua County, Fla., April 18, 1890 (Pearson); Charleston, S. C., April 25, 1908 (Wayne); Charleston, S. C., April 7, 1910 (Wayne) (unusually early); Mattamuskeet Lake, N. C., April 30, 1908 (Pearson); Baltimore, Md., April 30, 1892 (Gray); Syracuse, N. Y., May 14, 1881 (Rich); Portland, Conn., April 17, 1872 (Merriam); Essex County, Mass., May 12, 1896 (Mann); Penobscot Bay, Me., May 26, 1897 (Knight); Philo, Ill., May 12, 1902 (Hess); Manawa Lake, Iowa, May 15, 1904 (Trostler); near San Francisco, Cal., April 21, 1904 (Finley).

Eggs were just hatching April 13, 1895, at Tallahassee, Fla., which must have been laid in March (Williams); young just out of the nest June 20, 1903, at Falmouth, Me. (Norton); young in nest September 15, 1901, at Alameda, Cal. (Cohen); full-grown young April 23, 1878, at Lomita, Tex. (Sennett). The average date of finding eggs at Barr Lake, Colo., was May 12, earliest May 9, 1909, but young in nest May 24, 1907, indicated that some eggs had been laid at a still earlier date (Rockwell).

Fall migration.

Place.	Number of years' records.	Average date of the last one seen.	Latest date of the last one seen.
Philadelphia, Pa. (near).....	3	Oct. 23	Nov. 7, 1893
New York, N. Y. (near).....	4	Oct. 8	Oct. 17, 1904
Hartford, Conn.			Oct. 11, 1888
Providence, R. I.	4	Oct. 24	Nov. 22, 1908
Southeastern Massachusetts.....	6	Oct. 10	Nov. 6, 1890
Durham, N. H.			Oct. 1, 1900
Portland, Me.			Sept. 16, 1907
Montreal, Canada.....	4	Sept. 13	Oct. 11, 1895
Quebec City, Canada.....			Oct. 15, 1894
Chicago, Ill.	7	Sept. 23	Oct. 20, 1906
Ottawa, Ontario.....	9	Oct. 13	Oct. 27, 1894
Delavan, Wis.	2	Sept. 23	Sept. 24, 1894
Heron Lake, Minn.....			Nov. 14, 1885
Richmond, Kans.			Oct. 15, 1885
Lincoln, Nebr.			Oct. 27, 1900
Huron, S. Dak.			Oct. 18, 1887
Sioux Falls, S. Dak.....			Nov. 20, 1910
Barr Lake, Colo.	2	Oct. 7	Oct. 11, 1903

[**Agami Heron.** *Agamia agami* (Gmelin).]

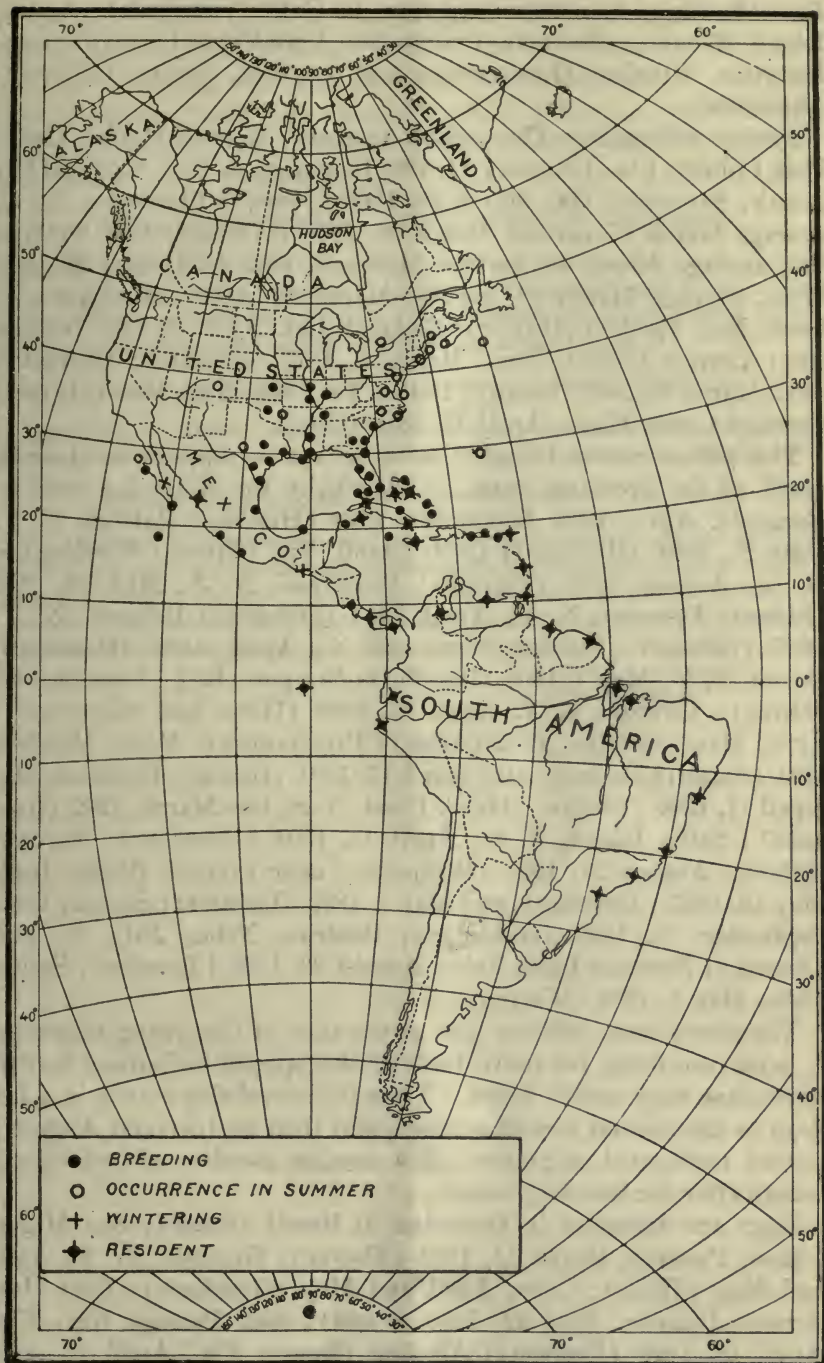
A nonmigratory species ranging west to Palenque, Chiapas (Nelson and Goldman), and to Rio Coatzacoalcas, Vera Cruz (Sumichrast). It is rare and local in British Honduras, Guatemala, and Costa Rica, more common in Panama, and has a wide range in northern South America, south to Yurimaguas, Peru, and to Matto Grasso, Brazil.]

Yellow-crowned Night Heron. *Nyctanassa violacea* (Linnæus).

Range.—Temperate and tropical America, north to South Carolina, Illinois, Kansas, and Lower California; south throughout the West Indies and Central America to Brazil and Peru.

Breeding range.—The yellow-crowned night heron is a common breeding bird in Florida and the lower parts of the Gulf States. On the Atlantic coast it breeds north to Charleston, S. C. (Wayne). It nests much farther north, however, in the Mississippi Valley even at the mouth of the Illinois River (Widmann); to Mount Carmel, Ill. (Nelson); Bicknell, Ind. (Chansler); Crooked Creek, Kans. (Goss); Fort Reno, Okla. (Merrill); Gurley, Tex. (Howell); and Laredo, Tex. (Butcher). The northern limit of the breeding range on the Pacific coast is found at Mazatlan, Sinaloa, at Magdalena Bay, Lower California, and on Socorro Island. The species is a common breeder in the Bahamas and the West Indies, and less commonly and somewhat locally throughout Central America and northern South America south to Paranagua, Brazil (Pelzeln); and Tumbes, Peru (Taczanowski).

Winter range.—The yellow-crowned night heron seems to desert the United States during the winter, though an injured bird spent the winter of 1909–10 at Upper Matecumbe Key, Fla. (Brodhead), and two birds were seen during January, 1912, near Brownsville,

FIG. 21.—Yellow-crowned night heron (*Nyctanassa violacea*).

Tex. (Smith). It winters, however, in Cuba (Gundlach); Andros Island, Bahamas (Bonhote); Santa Ana, Vera Cruz (Ferrari-Perez); Mazatlan, Sinaloa (Lawrence); and La Paz, Lower California (Brewster).

Spring migration.—The earliest migrants reached Catfish Creek, Polk County, Fla., February 14, 1901 (specimen in U. S. National Museum); Savannah, Ga., March 28, 1909 (Perry); Charleston, S. C., average March 25, earliest March 23, 1907 (Wayne); New Orleans, La., average March 19, earliest March 9, 1895 (Allison); Rodney, Miss., average March 25, earliest March 20, 1890 (Mabbett); St. Louis, Mo., April 10 (Hurter); Bicknell, Ind., April 13, 1908 (Chansler); Corpus Christi, Tex., March 8, 1877 (Sennett); Galveston, Tex., March 20, 1892 (Lloyd); Dallas, Tex., March 28, 1898 (Mayer); Crooked Creek, Kans., April 17, 1878 (Goss).

The yellow-crowned night heron is apt to appear in districts north of the breeding range, as shown by the following records: Bermuda, April, 1848, September, 1849 (Hurdis); Raleigh, N. C., June 25, 1894 (Brimley); Cobb Island, Va. (Rives); Washington, D. C., August, 1901 (Palmer); Woodbine, N. J., May 23, 1892 (Stone); Freeport, N. Y., April, 1893 (Dutcher); Bellport, N. Y., 1897 (Babson); Wading River, N. Y., April, 1901 (Hoffman); Orient, N. Y., May 4, 1905 (Braislin); Newport, R. I., June 15, 1778 (Howe); Tiverton, R. I., April 23, 1886 (Howe and Sturtevant); Lynn, Mass., October, 1862 (Allen); Provincetown, Mass., March 8, 1891 (Small); Deering, Me., April 13, 1901 (Brock); Portland, Me., April 11, 1906 (Norton); Hawk Point, N. S., late March, 1902 (Kennard); Sable Island, N. S., April 13, 1904 (Bontelier); Toronto, Ontario, August 15, 1898 (Williams); near Council Bluffs, Iowa, May 10, 1843 (Audubon), and May 1, 1892 (Trostler); Sabula, Iowa, September 15, 1892 (Giddings); Beatrice, Nebr., July 19, 1901 (Swenk); Florence Lake, Nebr., August 23, 1903 (Trostler); Salida, Colo., May 1, 1908 (Warren).

The above dates indicate that at the time of the spring migration it is no rare thing for individuals of this species to journey farther north than they usually breed. These birds probably return in a few days to the normal breeding range, and then in July and August a second northward migration of a smaller number of individuals occurs after the breeding season.

Eggs are deposited in December in Brazil (Euler); San Miguel Island, Panama, March 14, 1904 (Thayer); Grenada, W. I., April and May (Wells); Cuba, April and May (Gundlach); Port Henderson, Jamaica, June 12, 1890 (Field); near Passage Key, Fla., April 18, 1906 (Pearson); Alachua County, Fla., April 25, 1888 (Pearson); Charleston, S. C., April 20, 1896 (Wayne); Wheatland, Ind., April 27, 1881 (Ridgway); Mount Carmel, Ill., May 6, 1874

(Nelson); Nueces County, Tex., May 22, 1884 (Benners); Socorro Island, Mexico, fledged young May 14, 1897 (Anthony). An unusually early nesting was that of birds which had already laid their eggs by March 23, 1907, at Charleston, S. C. (Wayne), while the eggs that were found hatched March 5, 1890, at Key West, Fla., must have been laid in early February.

[Lineated Tiger-bittern. *Tigrisoma lineatum* (Boddaert).]

The lineated tiger-bittern ranges north to Panama, where it has been taken at Lion Hill, March, 1900 (Brown), and at Rio Indio, February 23, 1911 (Goldman). Thence it spreads over much of northern South America, south to Peru (Pebas and Yurimaguas) and to Barretos, Sao Paulo, Brazil.]

[Nicaraguan Tiger-bittern. *Tigrisoma excellens* Ridgway.]

Restricted to Middle America, where it has been taken from the Segovia River, Honduras (Townsend), to the Rio Escondido, Nicaragua (Richmond).]

[Mexican Tiger-bittern. *Heterocnus mexicanus* (Swainson).]

The Mexican tiger-bittern is one of the common members of the family in Mexico and Central America and ranges north almost to the United States, to Alamos, Sonora; Victoria, Tamaulipas; and Cozumel Island, Yucatan. The southern limit is found in Panama, where it has been taken east to the Bay of Panama (Kellett and Wood) and to the line of the Panama Railroad (McLean-nan).]

INDEX.

	Page.		Page.
<i>adoza</i> , <i>Ardea herodias</i>	37	Egret.....	40
Agami heron.....	64	Reddish.....	49
<i>Agamia agami</i>	64	Snowy.....	45
<i>Ajaia ajaia</i>	12	<i>Egretta candidissima</i>	45
<i>alba</i> , <i>Guara</i>	14	<i>egretta</i> , <i>Herodias</i>	40
<i>americana</i> , <i>Mycteria</i>	22	European heron.....	40
Anthony green heron.....	58	<i>excellens</i> , <i>Tigrisoma</i>	67
<i>anthonyi</i> , <i>Butorides virescens</i>	58	<i>exilis</i> , <i>Izobrychus</i>	29
<i>Ardea cinerea</i>	40	<i>fannini</i> , <i>Ardea herodias</i>	36
<i>herodias adoza</i>	37	Flamingo.....	10
<i>cognata</i>	38	<i>Florida caerulea</i>	52
<i>fannini</i>	36	Frazar green heron.....	59
<i>herodias</i>	33	<i>frazari</i> , <i>Butorides virescens</i>	59
<i>hyperonca</i>	37	Galapagos great blue heron.....	38
<i>lessoni</i>	37	Glossy ibis.....	17
<i>sanctilucae</i>	38	White-faced.....	19
<i>treganzai</i>	36	Great blue heron.....	33
<i>wardi</i>	36	California.....	37
<i>occidentalis</i>	33	Galapagos.....	33
<i>autumnalis</i> , <i>Plegadis</i>	17	Lower California.....	33
Bittern.....	26	Mexican.....	37
Cory least.....	32	West Indian.....	37
Least.....	29	Great white heron.....	33
Black-crowned night heron.....	60	Green heron.....	56
Blue heron, California great.....	37	Anthony.....	58
Galapagos great.....	38	Frazar.....	59
Great.....	33	Lembeye.....	60
Little.....	52	<i>Guara alba</i>	14
Lower California great.....	38	<i>rubra</i>	16
Mexican great.....	37	<i>guarauna</i> , <i>Plegadis</i>	19
West Indian great.....	37	<i>Harpiprion cayennensis</i>	24
Boatbill, Zeledon.....	55	<i>Herodias egretta</i>	40
<i>Botaurus lentiginosus</i>	26	<i>herodias adoza</i> , <i>Ardea</i>	37
<i>pinnatus</i>	29	<i>cognata</i> , <i>Ardea</i>	33
<i>Butorides brunescens</i>	60	<i>fannini</i> , <i>Ardea</i>	36
<i>striata</i>	60	<i>herodias</i> , <i>Ardea</i>	33
<i>virescens</i>	56	<i>hyperonca</i> , <i>Ardea</i>	37
<i>anthonyi</i>	58	<i>lessoni</i> , <i>Ardea</i>	37
<i>frazari</i>	59	<i>sanctilucae</i> , <i>Ardea</i>	33
<i>brunescens</i> , <i>Butorides</i>	60	<i>treganzai</i> , <i>Ardea</i>	36
<i>caerulea</i> , <i>Florida</i>	52	<i>wardi</i> , <i>Ardea</i>	36
California great blue heron.....	37	Heron, Agami.....	64
<i>candidissima</i> , <i>Egretta</i>	45	Anthony green.....	58
<i>cayennensis</i> , <i>Harpiprion</i>	24	Black-crowned night.....	60
Cayenne ibis.....	24	California great blue.....	37
<i>cinerea</i> , <i>Ardea</i>	40	European.....	40
<i>Cochlearius zeledoni</i>	55	Frazar green.....	59
<i>cognata</i> , <i>Ardea herodias</i>	38	Galapagos great blue.....	38
Cory least bittern.....	32	Great blue.....	33
Demi-egret.....	52	Great white.....	33
<i>Dichromanassa rufescens</i>	49	Green.....	56
Distribution of herons.....	8	Lembeye green.....	60

	Page.		Page.
Heron, Little blue	52	Night heron, Black-crowned	60
Louisiana	51	Yellow-crowned	64
Lower California great blue	38	Northwestern coast heron	36
Mexican great blue	37	<i>Nyctanassa violacea</i>	64
Northwestern coast	36	<i>Nycticorax nycticorax naevius</i>	60
Pileated	55	<i>occidentalis</i> , <i>Ardea</i>	33
Pinnated	29	<i>Phoenicopterus ruber</i>	10
Striated	60	Pileated heron	55
Treganza	36	<i>Pilherodius pileatus</i>	55
Ward	36	Pinnated heron	29
West Indian great blue	37	<i>pinnatus</i> , <i>Botaurus</i>	29
Yellow-crowned night	64	<i>Plegadis autumnalis</i>	17
Hérons, distribution	8	<i>guarauna</i>	19
migration	9	Reddish egret	49
tables of ranges	9	Roseate spoonbill	12
<i>Heterocnus mexicanus</i>	67	<i>ruber</i> , <i>Phoenicopterus</i>	10
<i>Hydranassa tricolor ruficollis</i>	51	<i>rubra</i> , <i>Guara</i>	16
<i>tricolor</i>	52	<i>rufescens</i> , <i>Dichromanassa</i>	49
<i>hyperonca</i> , <i>Ardea herodias</i>	37	<i>ruficollis</i> , <i>Hydranassa tricolor</i>	51
Ibis, Cayenne	24	<i>sanctilucae</i> , <i>Ardea herodias</i>	38
Glossy	17	Scarlet ibis	16
Scarlet	16	Snowy egret	45
White	14	spoonbill, Roseate	12
White-faced glossy	19	<i>striata</i> , <i>Butorides</i>	60
Wood	22	Striated heron	60
<i>Izobrychus exilis</i>	29	Tiger-bittern, Lineated	67
<i>neoxenus</i>	32	Mexican	67
Jabiru	24	Nicaraguan	67
<i>mycteria</i>	24	<i>Tigrisoma excellens</i>	67
Least bittern	29	<i>lineatum</i>	67
Cory	32	Treganza heron	36
Lembeye green heron	60	<i>treganzai</i> , <i>Ardea herodias</i>	36
<i>lentiginosus</i> , <i>Botaurus</i>	26	<i>tricolor ruficollis</i> , <i>Hydranassa</i>	51
<i>lessoni</i> , <i>Ardea herodias</i>	37	<i>tricolor</i> , <i>Hydranassa</i>	52
Lineated tiger-bittern	67	<i>violacea</i> , <i>Nyctanassa</i>	64
<i>lineatum</i> , <i>Tigrisoma</i>	67	<i>virescens anthonyi</i> , <i>Butorides</i>	58
Little blue heron	52	<i>frazari</i> , <i>Butorides</i>	59
Louisiana heron	51	<i>virescens</i> , <i>Butorides</i>	56
Lower California great blue heron	38	Ward heron	36
Mexican great blue heron	37	<i>wardi</i> , <i>Ardea herodias</i>	36
tiger-bittern	67	West Indian great blue heron	37
<i>mexicanus</i> , <i>Heterocnus</i>	67	White-faced glossy ibis	19
Migration of herons	9	White heron, Great	33
<i>Mycteria americana</i>	22	ibis	14
<i>mycteria</i> , <i>Jabiru</i>	24	Wood ibis	22
<i>naevius</i> , <i>Nycticorax nycticorax</i>	60	Yellow-crowned night heron	64
<i>neoxenus</i> , <i>Izobrychus</i>	32	Zeledon boatbill	55
Nicaraguan tiger-bittern	67	<i>zeledoni</i> , <i>Cochlearius</i>	55

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 497.

I

SOME COMMON GAME, AQUATIC,
AND RAPACIOUS BIRDS IN
RELATION TO MAN.

BY

W. L. McATEE and F. E. L. BEAL,
Assistants, Biological Survey.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1912.

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., March 18, 1912.

SIR: I have the honor to transmit herewith and to recommend for publication as a Farmers' Bulletin a report on Some Common Game, Aquatic, and Rapacious Birds in Relation to Man, by W. L. McAtee and F. E. L. Beal, assistants in the Biological Survey. Careful study of the food habits of the game birds, including the group known as shore birds, shows that these birds are of great value to the farmer. The water birds, as the grebes, gulls, and terns, have greater economic value and do less harm than is ordinarily supposed; while some species, like Franklin's gull and the black tern, are markedly beneficial. It is pointed out in this bulletin that many birds of prey are exceedingly valuable to the farmer, but the opposite is true of the Cooper's hawk, the sharp-shinned hawk, and the goshawk, which should be destroyed as the determined foes of poultry, game birds, and most of the smaller insectivorous species.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction.....	5
Prairie chicken (<i>Tympanuchus americanus</i>).....	5
California quail (<i>Lophortyx californica</i>).....	7
Ruffed grouse (<i>Bonasa umbellus</i>).....	12
Introduced pheasants (<i>Phasianus torquatus</i> and <i>P. colchicus</i>).....	13
Upland plover (<i>Bartramia longicauda</i>).....	14
Killdeer (<i>Oxyechus vociferus</i>).....	16
Horned grebe (<i>Colymbus auritus</i>).....	18
Franklin's gull (<i>Larus franklini</i>).....	19
Terns (<i>Sterna maxima</i> , <i>S. forsteri</i> , <i>S. hirundo</i> , <i>S. antillarum</i> , and <i>Hydrochelidon nigra surinamensis</i>).....	22
Cooper's hawk (<i>Accipiter cooperi</i>).....	26
Rough-legged hawk (<i>Archibuteo lagopus sancti-johannis</i>).....	27
Sparrow hawk (<i>Falco sparverius</i>).....	28
Long-eared owl (<i>Asio wilsonianus</i>).....	29
Screech owl (<i>Otus asio</i>).....	29

ILLUSTRATIONS.

	Page.
FIG. 1. Prairie chicken.....	6
2. California quail.....	8
3. Ruffed grouse.....	12
4. Ringneck pheasant.....	13
5. Upland plover.....	15
6. Killdeer.....	17
7. Horned grebe.....	19
8. Franklin's gull.....	20
9. Common tern.....	23
10. Black tern.....	25
11. Cooper's hawk.....	26
12. Rough-legged hawk.....	27
13. Sparrow hawk.....	28
14. Screech owl.....	30

SOME COMMON GAME, AQUATIC, AND RAPACIOUS BIRDS IN RELATION TO MAN.

INTRODUCTION.

Game and aquatic birds, as a rule, have less economic interest than the species more closely associated with man. Nevertheless nearly all aquatic birds have important relations with the fishing industry. One of the birds, the horned grebe, sometimes accused of living entirely upon fish, is here shown to feed largely on crawfish, other crustaceans, and insects. Terns also have been held responsible for the serious reduction of food fishes in some localities, but a careful study of their food habits demonstrates that only a small proportion of their diet consists of such fishes. On account of the relatively small number of terns it is manifestly impossible for them to do all the damage attributed to them even if they fed exclusively on food fishes. Certain aquatic birds approach the land birds in feeding habits; examples are Franklin's gull and the black tern, both of which by their destruction of insects are beneficial to man. All the shore birds are strikingly beneficial in their food habits, and the slaughter of these game birds deprives the farmer of valuable allies against some of the worst crop pests. The food habits of the upland plover and killdeer are here described as illustrating the beneficial qualities of the group. The gallinaceous game birds, as quail, grouse, and pheasants, take far less insect food than the shore birds, yet all of them do a certain amount of good. Because of their close contact with crops it is important that their economic relations be made widely known.

The hawks and owls have a bad name, but for the most part it is undeserved, and indiscriminate persecution of these birds is a serious mistake. Accounts of six species are given in this bulletin in order to point out the distinction between injurious hawks and owls and useful ones. The latter should be carefully protected.

PRAIRIE CHICKEN.

(*Tympanuchus americanus*.)

The prairie chicken (fig. 1), now common only in Kansas, Nebraska, Minnesota, the Dakotas, and Manitoba, is one of the birds which formerly occurred over a much wider range than at present and in

NOTE.—A list giving the titles of all Farmers' Bulletins available for distribution will be sent free upon application to a Member of Congress or the Secretary of Agriculture.

far greater abundance. It has been reduced principally by hunters, as have so many of our finest species of birds. Many sportsmen declare allegiance to the highest principles of game preservation yet fail to practice these principles. Our present game laws, even though efficiently administered, will save no species of birds, as the



FIG. 1.—Prairie chicken.

its family the prairie chicken is very prolific, and if adequately protected would soon become numerous in its old haunts. The bird is easily domesticated, hence is eminently suited for propagation on preserves. As the increase of game in this manner is the only way to preserve it indefinitely and at the same time allow hunting, the plan

rapid growth of the army of sportsmen and 'pot hunters more than counterbalances the effect of the shortening of open seasons and reduction of bag limits. Moreover, game laws, as a general rule, are not strictly obeyed. In southern Wisconsin, where there was a closed season on prairie chickens for a term of years, to the writers' knowledge these birds were killed at every opportunity. The customary excuse was: "They are so scarce they won't breed up again anyway." Aside from showing culpable willingness to assist in the birds' extermination, this remark is untrue. Like all birds of

should be actively put into operation by those most interested in the preservation of game—the sportsmen.

The prairie chicken is valuable not only as game, but as an efficient destroyer of farm pests, and any farmer would profit by having these birds reared on his place. Almost 15 per cent of the bird's food consists of weed seeds, including those of such pests as foxtail grass, smartweeds, and ragweed. More than 10 per cent of the diet consists of rose hips. A few other fruits are eaten and more than a fourth of the food consists of leaves, flowers, and shoots, collectively known as browse. The prairie chicken eats a great deal of grain, but takes most of it from stubble. The bird is fond of such mast as hazelnuts and acorns.

Nearly 15 per cent of the bird's food consists of insects, the bulk of them being grasshoppers. Almost every kind of grasshopper, locust, or cricket appears to be acceptable, and nearly 20 different kinds were identified from the stomachs. The prairie chicken made itself especially useful during the destructive invasions of the Rocky Mountain locust. Sixteen birds examined at that time were found to have eaten 866 locusts. Among other pests eaten by this species are the Colorado potato beetle, 12-spotted cucumber beetle, sugar-beet leaf-beetle, May beetles, cotton worm, army worm, cutworms, the yellow bear caterpillar, and chinch bug.—W. L. M.

CALIFORNIA QUAIL.

(*Lophortyx californica*.)

The California quail (fig. 2) is common and generally distributed over the States west of the Sierra, except at the higher altitudes, and is especially abundant in the fruit-raising sections. Like the bobwhite of the East, this quail never goes far from cover, and it delights to dwell on unimproved land where trees and chaparral alternate with small areas of open ground. In settled regions it is somewhat domestic in habits and soon becomes accustomed to living in orchards, gardens, and cultivated grounds. The writer has seen a female sitting upon her eggs in a garden within 30 feet of a house, between which and the nest carriages and foot passengers passed many times each day. In winter a covey frequently feeds with the farmer's chickens, and if not disturbed will continue to do so until pairing time.

The natural food of the quail consists of the seeds of the vast number of plants known as weeds, with a little foliage of the same, especially in winter, when the leaves are young and tender. Considering how small is the amount of fruit usually found in the stomach of this bird, it is a surprise to learn that it sometimes does serious damage to vineyards. Investigation, however, shows that, as in most other similar cases, the injury results only when too many birds gather

in a limited area. Nearly all the complaints against the quail for eating fruit are that it visits vineyards in immense numbers and eats grapes. When thousands visit a vineyard, even if only occasionally, and each bird eats or spoils at least one grape, the result is disastrous.

An observer states that he once saw a flock of about 1,000 quail



FIG. 2.—California quail.

eating Zinfandel grapes in a vineyard in the central part of the State, and another says that in southern California he has seen as many as 5,000 feeding upon Muscat grapes. In the writer's interviews with California fruit growers, only one mentioned the quail as harmful. His ranch was situated along the hills on the side of a narrow valley, adjacent to wild grazing land with much chaparral and forest, among which the quail lived. In this case the annual loss was estimated at 2 or 3 tons of grapes.

In the laboratory investigation of the food of the California quail 619 stomachs were examined. They were collected in every month except May, but only

one was obtained in March. The other months are well represented. Animal food, principally insects, amounts to but 3 per cent, and most of this was found in the stomachs of young birds, mere broodlings. Vegetable food amounts to 97 per cent and consists mainly

of seeds of plants most of which are of noxious or troublesome species.

Animal food.—Ants appear to be a favorite food. They were found in 82 stomachs, and were eaten by adults as well as by young. They amount, however, to less than 1 per cent of the whole diet. The rest of the animal food aggregates a little more than 2 per cent and is distributed as follows: Beetles in 30 stomachs, bugs (Hemiptera) in 38, caterpillars in 11, grasshoppers in 7, flies in 2, spiders in 6, millepeds in 1, and snails in 2. The most interesting point in this connection was the stomach of a broodling only 3 or 4 days old. Besides several adult Hemiptera, some ants, caterpillars, and spiders, and a few seeds, it contained 280 minute insects, which constituted 76 per cent of the stomach's contents, and were identified as an immature form of species of scale, *Phenacoccus helianthi*.

In this connection the following extract from a letter dated at Los Angeles, Cal., October 28, 1908, by Dr. W. G. Chambers to the Secretary of Agriculture, is interesting:

Last May during the hatching season one of my female quail died a week prior to completing the hatch. An incandescent light of 8 candlepower was substituted, the result being 15 baby quail, very wild at first, not understanding human sounds or language, but finally becoming as docile as pet chickens. They were raised in my back yard, running at large after the first week.

A number of Marguerite bushes which grow in profusion in the yard were so infested with black scale that I had decided to uproot them and had postponed doing so as the little quail worked so persistently among the branches; upon investigation I discovered them eating the scale and twittering happily; they would swallow the fully developed scale and thoroughly clean the branches of all those undeveloped.

The young in the first week of life eat animal matter to the extent of from 50 to 75 per cent of the food, but by the time they are 4 weeks old they take little if any more animal food than the adults.

Vegetable food.—The vegetable part of the quail's food may be divided into fruit, grain, seeds, and forage. Fruit appeared in 106 stomachs and aggregates 2.3 per cent of the yearly diet. It was distributed as follows: Grapes in 7 stomachs, prunes in 9, apples in 3, rubus (blackberry or raspberry) in 4, olive in 1, elderberry in 21, snowberry in 8, Manzanita in 2, huckleberry in 11, and rose haws in 3. Pulp and skins, identified as fruit only, were found in 27 stomachs, and unknown seeds, probably those of some small fruit or berry, occurred in 10 stomachs. It is evident that the percentage of any one of the above is insignificant. Stomach examination throws no new light upon the quail's grape-eating habits, except to show that the ravages complained of are exceptional. That fruit does not constitute any important part of the bird's annual food is clearly proved.

Grain was found in 133 stomachs and constitutes 6.4 per cent of the food. It was distributed as follows: Corn in 14 stomachs, wheat in 15, oats in 13, barley in 89, and rye in 2. The principal complaints against the quail on the score of grain eating are that flocks sometimes visit newly sown fields and eat large quantities of the seed. Walter E. Bryant says on this point:

Two males which I shot one evening as they were going to roost for the night after having been feeding on a newly sown field contained the following, mainly in the crop: (a) Two hundred and ten whole grains of barley, 6 pieces of broken barley, 3 grains of "cheat," and 1 of wheat, besides a few barley hulls, some clover leaves, and alfilaria; (b) 185 whole grains of barley, 5 broken pieces, 4 grains of "cheat," and 2 of wheat; also barley hulls, clover, and alfilaria. The flock numbered nearly or quite 20 birds.¹

Only one report accuses the bird of eating grain from the harvest field. Mr. W. T. Craig, of San Francisco, writing to the United States Department of Agriculture, says:

I have observed the quail enter a field of wheat to the number of thousands, and had they not been driven away they would have destroyed the whole crop.

Stomach examination does not indicate any month in which grain is eaten in excess of other food. January shows the highest percentage, 12.4, but November is nearly as high, while December, although between the two, shows less than 3 per cent. A little more than 3 per cent was eaten in February, and none at all in March and April, though the newly sown grain would be accessible in one at least of these months. June and July, the harvest months, show, respectively, 4.1 per cent and 10.7 per cent. In fact the stomach record plainly indicates that the quail does not make special search for grain, but being naturally a seed eater takes grain when it comes in the way.

The seeds of a multitude of plants which have no apparent useful function except to increase by their decay the deposit of humus in the soil constitute the staff of life of the quail. In this particular investigation they aggregate 62.5 per cent of the food of the year. They appear in stomachs taken in every month and reach a good percentage in each, the only months that show much diminution in quantity being January, February, March, and April, when new forage partly replaces seeds. The percentage is highest in June, 85.9, but shows no great falling off from July to December, inclusive. Seventy-three kinds of seeds were identified, at least generically, and more than half of them were determined specifically. Many more were ground up so as to be unrecognizable.

Bur thistle, lupines, bur clover, and turkey mullein appear to be the favorite seeds; that the others are not distasteful is shown by the quantities found in some stomachs. For instance, mayweed was identified in only 27 stomachs, yet one stomach contained at least 2,000 of these seeds; pigweed (*Chenopodium*) in but 11, yet 1 con-

¹ Zee, IV, pp. 55-56, 1893-94.

tained 1,000. One stomach held 83 kernels of barley, 592 seeds of geranium, 560 of tarweed, 40 of bur thistle, 48 of clover, 80 of alfilaria, 704 of timothy, 32 of catchfly, and 5 of snowberry, or 2,144 seeds in all. Another contained 1,696 geranium seeds, 14 bur thistle, 24 knotweed, 14 tarweed, 38 bur clover, 148 alfilaria, 12 ray grass, and 1 unknown seed, and a pod of uncertain origin—in all, 1,947 seeds and a pod. In both cases the contents of the crop is included with that of the stomach or gizzard. These samples indicate considerable variety in the quail's diet, even in one meal.

Grass and other forage constitute a little over 25 per cent of the quail's annual food. Forage amounts to less than 1 per cent in June, remains about the same until October, and increases somewhat in November. In January it becomes important, and it reaches nearly 60 per cent of the food for the next four months. The maximum, 85 per cent, occurs in March; but this percentage, based on only one stomach, can not be considered final. Seeds and forage are practically complementary to each other; that is, as one increases the other decreases. June, which shows the least forage, has the largest percentage of seeds. Leaves of red and of bur clover and of alfilaria were the favorite kinds, and in some cases constituted the whole stomach contents. Blades of grass are frequently taken. A few bits of acorn, and perhaps other nuts, were eaten, but the quantity is insignificant.

Summary.—From the above analysis of the food of the California quail it is apparent that under normal conditions the farmer and fruit grower have nothing to fear from its ravages. When, however, large areas of chaparral land are cleared and brought under cultivation, it is natural that the products of garden and vineyard should be eaten to a greater or less extent by quail, which abound in such localities. On the other hand, its seed-eating record is in its favor. Usually there is little difficulty in getting rid of a superfluity of game birds; in fact, in most cases the trouble is to prevent their extermination. This is strikingly illustrated by the fact that, in order to restock its depleted covers, an attempt is now being made in southern California to import quail from the peninsula of Lower California. A bird so large, so easily trapped, so valuable for food, and withal one whose pursuit affords such excellent sport as the valley quail, will rarely become numerous enough to do serious damage, and then only locally and under unusual conditions. When such conditions arise, a reduction of numbers is the easiest and simplest cure. Permits to trap quail on one's own premises are obtainable in California on application to the State fish commissioner. After the birds have been sufficiently reduced they can be kept within reasonable limits by a moderate amount of shooting in the proper season.—F. E. L. B.

RUFFED GROUSE.

(Bonasa umbellus.)

The ruffed grouse (fig. 3), called "partridge" in the northeastern States and pheasant in some other parts of its range, is one of our most widely ranging game birds. It inhabits wooded regions from



FIG. 3.—Ruffed grouse.

Canada and Alaska south to California, Colorado, Tennessee, and northern Georgia. It is usually a wild and wary bird and well withstands the attacks of hunters, but it responds to protection in a gratifying manner and has proved to be well adapted to propagation under artificial conditions. On account of these qualities and its desirability as a game species it is a good subject for game farming.

Wild fruits, mast, and browse make up the bulk of the vegetable food of this species. It is very fond of hazelnuts, beechnuts, chestnuts, and acorns and it eats practically all kinds of wild berries and other fruits.

Nearly 60 kinds of

fruits have been identified from the stomach contents examined. Various weed seeds are also consumed.

Slightly more than 10 per cent of the food consists of insects, about half of which are beetles. The most important pests devoured are the Colorado potato beetle, clover-root weevil, the pale-striped flea

beetle, grapevine leaf-beetle, May beetles, grasshoppers, cotton worms, army worms, cutworms, the red-humped apple caterpillar, and sawfly larvæ.—W. L. M.

INTRODUCED PHEASANTS.

(*Phasianus torquatus* and *P. colchicus*.)

While introduced pheasants may hardly seem to deserve a place on a list of common birds, the extent to which they are being imported and propagated in the United States makes it desirable that information be made available as to their feeding habits when liberated. Ringneck pheasants (fig. 4) have long been established in Oregon, Washington, and British Columbia, and are less common in the wild state in Massachusetts, New York, Indiana, and Kansas. But persistent efforts, in some cases on a very large scale, are being made to establish pheasants in other States, and the farmers whose land they are likely to range over should have access to information concerning their economic value.

Severe criticism of pheasants and fulsome praise are about equal in volume. The birds are accused of digging newly planted and sprouting corn, oats, barley, and beans, and seeds of melons, cucumbers, and squashes. It is claimed that



FIG. 4.—Ringneck pheasant.

because of their depredations it has been necessary to replant whole fields of corn. They are said to drive chickens away from their food and even to kill young poultry. Some landowners in Ontario County, N. Y., claim that the loss suffered on account of pheasants has been more than twice the amount of their taxes.

On the other hand the birds have not proved a nuisance in Oregon and Washington, where they have been numerous for years. Some farmers even value them so highly that they will not permit hunting on their property.

The few pheasant stomachs examined indicate that these birds are very fond of grain. Oats and wheat compose about 34 per cent of the food of 12 ringneck pheasants collected in Oregon and Washington, and 82.5 per cent of the stomach contents of two English pheasants from British Columbia. But all of these birds were taken in September, October, and December; hence it is probable that all of this grain was waste. The next largest item of food in these stomachs was insects, consisting entirely of larvæ of March flies (*Bibio*). One stomach contained no fewer than 360 of these larvæ and another 432. The remainder of the food included acorns, pine seeds, browse, peas, rose hips, snowberries, and seeds of dandelion, lupine, bur clover, black mustard, and chickweed.

From 200 to 960 kernels of wheat and oats were taken by various birds; about 200 peas were found in one stomach, but it was evident that these were the old and partly decomposed refuse of the harvest. Twenty-three acorns and 200 pine seeds were taken by the bird which ate the largest amount of mast, and about 800 capsules of chickweed, containing more than 8,000 seeds, were in the stomach of the best weed-seed eater.

What is most evident is that pheasants are gross feeders; their capabilities for good or harm are great. If a number of them attack a crop they are likely to make short work of it, or if they devote themselves to weed seeds or insect pests they do a great deal of good. It seems therefore that the question of the economic value of pheasants is peculiarly a local one. Much depends on the proportion of land under cultivation, the kind of crops raised, and the quantity of wild food available. Apparently the chances are about even that imported pheasants will or will not become useful economic factors.—W. L. M.

UPLAND PLOVER.

(*Bartramia longicauda*.)

The upland plover (fig. 5) forms a striking exception in habits to its closest relatives, the sandpipers. While sandpipers love the vicinity of water, the upland plover frequents dry hills and prairies

and is most abundant in the interior. This so-called plover breeds from Oregon, Oklahoma, and Virginia north to Alaska, Mackenzie, and Maine, and migrates over the more southern parts of the continent, passing to the pampas of Argentina to spend the winters.

From its habits the upland plover would naturally be expected to have a closer relation to agriculture than most sandpipers, and such proves to be the case. Almost half its food is made up of grasshoppers, crickets, and weevils, all of which exact heavy toll from cultivated crops. Among the weevils eaten are the cottonboll weevil; greater and lesser clover-leaf weevils; clover-root weevil; *Epicærus imbricatus*, which is known to attack almost all garden and orchard crops; cowpea curculios; *Tanymecus confertus*, an enemy of sugar beets; *Thecesternus humeralis*, which has been known to injure grapevines; and bill bugs. *Thecesternus* alone composes 3.65 per cent of the seasonal food of the 163 stomachs examined, and bill bugs constitute 5.83 per cent. No fewer than 8 species of bill bugs were identified from the stomachs. These weevils injure, often seriously, such crops as corn, wheat, barley, and rye, as well as forage plants of many kinds.

The upland plover further makes itself useful to the farmer by devouring leaf-beetles, including the grapevine colaspis, southern corn leaf-beetle, and other injurious species; wireworms and their adult forms, the click beetles; white grubs and their parents, the May



FIG. 5.—Upland plover.

beetles; cutworms, army worms; cotton worms; cotton cutworms, sawfly larvæ; and leatherjackets or crane-fly larvæ. They befriend cattle by eating horseflies and their larvæ, and cattle ticks.

They eat a variety of other animal forms, such as moths, ants, and other Hymenoptera, flies, bugs, centipeds and millepedes, spiders, snails, and earthworms. Practically 97 per cent of the food consists of animal matter, chiefly of injurious and neutral forms. The vegetable food comprises the seeds of such weed pests as buttonweed, foxtail grass, and sand spurs, and hence is also to the credit of the bird.

Notwithstanding that the upland plover injures no crop and consumes a host of the worst enemies of agriculture, it is one of the numerous shore birds that have been hunted to the verge of extinction. Can it be that the American public will allow one of the best friends of agriculture to be exterminated by hunters who care only for the momentary excitement of dropping these swiftly flying birds and the pleasure of devouring the few mouthfuls of savory flesh they afford?—W. L. M.

KILLDEER.

(*Oxyechus vociferus*.)

The killdeer (fig. 6) is one of the best known American birds. It frequents cultivated lands and even roads and the vicinity of buildings. It is well named "vociferus," for it delights in repeating the loud and penetrating call of "kill-dee, kill-dee," from which its common name is taken. The killdeer nests throughout the United States and southern Canada. Some individuals spend the winter in the southern half of the United States or occasionally even farther north, while others go as far south as northern South America.

Like the upland plover the killdeer spends much of its time away from water. It frequently nests in cornfields or pastures and, as noted above, even comes about the abode of man. These preferences naturally influence the food habits of the species, affording it an opportunity to destroy insects which are directly related to agriculture. The food of the killdeer is varied, being composed of the following principal items: Beetles, 37.06 per cent; other insects, as grasshoppers, caterpillars, ants, bugs, caddis flies, dragon flies, and two-winged flies, 39.54 per cent; and other invertebrates, as centipeds, spiders, ticks, oyster worms, earthworms, snails, crabs, and other crustacea, 21.12 per cent. Vegetable matter composes 2.28 per cent of the total food, and is chiefly made up of weed seeds, such as buttonweed, smartweed, foxtail grass, and nightshade.

Among the injurious beetles consumed are the following weevils: Alfalfa weevil, cotton-boll weevil, clover-root weevil, clover-leaf

weevil, rice weevil, cowpea curculio, white-pine weevil, and bill bugs. The latter alone constitute more than 2 per cent of the whole food. The alfalfa weevil, a new and destructive pest, is relished by the killdeer, 41 being found in a single stomach. Other destructive beetles devoured are white grubs and their adult forms, the May beetles; wireworms and their imagoes, the click beetles; larvæ of the genus *Ligyris*, which attack sugar cane, corn, and carrots; brown-fruit beetles, which injure apples and corn; the grapevine leaf-beetle; southern corn-leaf beetle; two-striped tortoise beetle, which injures sweet potatoes; and a flea beetle which attacks tobacco and sugar beets.

Cicadas, buffalo tree hoppers, and negro bugs, the last named injuring parsley and raspberries, are some of the true bugs relished by the killdeer. Caterpillars are a favorite article of diet, and several very injurious species are eaten, as the cotton worm, cotton cutworm, other cutworms, and caterpillars of the genus *Phlegethontius*, which damage

tomatoes and tobacco. Grasshoppers and crickets, including mole crickets, are a staple food. Two-winged flies or Diptera furnish 11.91 per cent of the food of the killdeer. Such pests as crane flies and their larvæ, known as leatherjackets, are eaten, as well as horse-flies and mosquitoes and their larvæ. One stomach contained hundreds of larvæ of the salt marsh mosquito (*Aedes sollicitans*), which is one of the most troublesome of the biting species. The State of



FIG. 6.—Killdeer.

New Jersey has spent thousands of dollars in trying to reduce the numbers of this pest. The killdeer thus befriends man, but it does something also for the domestic animals, not only by eating horseflies and mosquitoes, as just mentioned, but also by preying upon ticks, including the American fever or cattle tick, which has caused such enormous losses in some parts of the South.

Crawfish, well-known pests in levees, and even in corn, cotton, and other fields in certain localities, are another item of the killdeer's food, and 3.62 per cent of the subsistence of the 228 birds examined was composed of worms of the genus *Nereis*, which prey upon oysters.

In all, 97.72 per cent of the killdeer's food is composed of insects and other animal matter. The bird preys upon many of the worst crop pests and is a valuable economic factor. There can be no logical reason for continuing to regard it as a game bird.—W. L. M.

HORNED GREBE.

(*Colymbus auritus*.)

Grebes are among the most interesting of water birds. Their power of diving as quick as a flash or of sinking beneath the surface without leaving a ripple has earned for them such names as hell-diver, sprite, and water witch. Grebes are not only accomplished divers, but swim well under water for long distances—not exclusively by aid of the feet, however, as is often stated. The writer has more than once seen the pied-bill grebe using its wings in underwater progression. Grebes have difficulty in rising from the water, but fly well when under way. When alighting they strike the water with a splash, gliding some distance on the breast. The nests are built of water-soaked vegetation, a portion of which is used to cover the eggs in the absence of the parents.

To illustrate the food habits of grebes, the horned grebe (fig. 7) is chosen. This species has a circumpolar range. In North America it breeds from the northern tier of the United States northward, and winters from the southern boundary of the breeding range south to Florida and California. The most remarkable point about the food habits of grebes is that the stomachs almost invariably contain a considerable mass of feathers. Feathers are fed to the young, and there is no question that they play some essential though unknown part in the digestive economy. As they are finely ground in the gizzards it is probable that finally they are digested and the available nutriment assimilated. Feathers constituted practically 66 per cent of the contents of the 57 horned grebe stomachs examined. However, it is not likely that they furnish a very large percentage of the nourishment needed by the birds. As the nutritive value of the feathers is unknown, this part of the stomach contents is ignored.

The other items of food are assigned 100 per cent, and the percentages are given on that basis. Various beetles, chiefly aquatic, compose 23.3 per cent of the food; other insects (including aquatic bugs, caddis and chironomid larvæ, dragon-fly nymphs, etc.), nearly 12 per cent; fishes, 27.8 per cent; crawfish, 20.7 per cent; and other crustacea, 13.8 per cent. A little other animal matter is taken, including snails and spiders, and a small quantity of vegetable food was found in two stomachs.

It has been claimed that grebes live exclusively on fishes and do mischief in fish hatcheries. The results obtained by stomach examinations show that they do not depend wholly or even chiefly upon



FIG. 7.—Horned grebe.

fish. On the contrary, they eat a large number of crawfishes, which often severely damage crops, and consume numbers of aquatic insects which devour small fishes and the food of such fishes.—W. L. M.

FRANKLIN'S GULL.

(*Larus franklini*.)

The term "gull" usually suggests a vision of dashing spray or far-extending beaches with reedy bays and outreaching points of sand or islets on which the birds rest to preen their feathers after their long flights, and where perchance they make their nests and rear their young. The species under consideration (fig. 8), however, spends little time on the seacoast but is an inhabitant of far-inland prairies and broad reaches of marsh land, where it lives and breeds during the warm season. In winter it retires southward, but lingers long enough in some of the Southern States to be of material

assistance to agriculture. Its center of abundance in North America during the breeding season is west of the Mississippi River and north of Iowa, east of the Rocky Mountains, but it is known to breed to some extent both south and east of these limits. The marshy lakes of this region afford ideal nesting sites for the species, while the adjoining broad stretches of prairie land yield an abundance of their favorite food. A few decades ago these birds occupied this vast region undisturbed, but to-day the plow is turning up the sod and the mower cutting the grass of the boundless fields over which for centuries they have foraged. With the advent of agricultural operations some changes harmful to the birds must necessarily take place, but it behooves the tillers of the soil to leave the gulls unmolested as far as possible, for where they abound they are a most potent

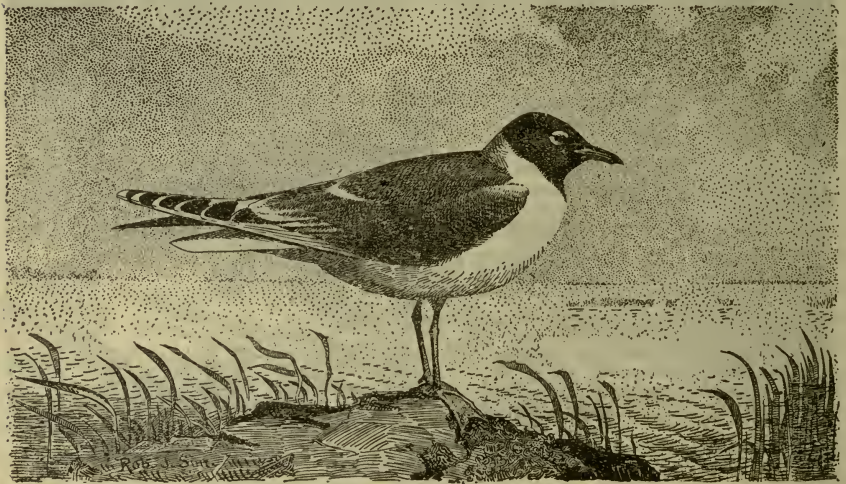


FIG. 8.—Franklin's gull.

factor in the reduction of insect life. They do not by any means confine themselves to marshes when seeking for food, but fly over the dry prairie and even visit cultivated fields, looking for grubs, grasshoppers, and other insects. When unmolested they become quite fearless and follow the plowman to gather the grubs and worms from the newly turned furrows.

In an investigation of the food of Franklin's gull 93 stomachs were examined. Nearly all were taken from their breeding grounds and in the breeding season. Unfortunately none were secured during July, which is probably the very height of the reproductive period.

Of the whole food 94.46 per cent consisted of animal matter and 5.54 per cent of vegetable. Of the latter nearly all was of no significance, probably being taken accidentally, except the contents of

2 stomachs collected in May in North Dakota. About 75 per cent of the contents of each of these consisted of wheat probably gathered from newly sown fields. This was the only vegetable food found in any stomach that was of the least economic value.

Of the animal food the most important item is grasshoppers. These amount to 43.43 per cent of the food of the season, and in September and October constitute over four-fifths of the whole diet. As an example of the number these birds can eat at a single meal, the following may be cited. Stomach A contained 70 entire grasshoppers and jaws of 56 more, with remains of 3 crickets. Stomach B contained 20 beetles, 66 crickets, 34 grasshoppers, and 3 other insects. Stomach C contained 90 whole grasshoppers, the jaws of 52 more, with 8 crickets, 1 bug, and 1 caterpillar. Stomach D contained 82 beetles, 87 bugs, 984 ants, 1 cricket, 1 grasshopper, and 2 spiders, or 1,157 insects in all. Stomach E was filled with 327 nymphs of dragon flies. Several other stomachs were completely filled with grasshoppers and crickets, too far advanced in digestion to be counted. Adults and larvæ (grubs) of May beetles were also a large component of the food and these were probably taken upon cultivated ground. Stomachs collected in Louisiana during the fall migration contained in addition to grasshoppers and beetles large numbers of true bugs (Hemiptera), including several species which are injurious to cotton, tobacco, and squashes. From this brief statement of the food of Franklin's gull, farmers will readily perceive that these birds are very desirable neighbors and will do all in their power to protect them.

There are several other species of gulls and terns that, like Franklin's, take up their residence about the lakes and marshes in the interior of the country. Their food habits, as far as known, are all beneficial to the farmer. They are great eaters of grasshoppers and have been seen catching those insects on the wing and also may often be seen following the plow in search of the grubs and beetles turned up. Among these are the California gull (*Larus californicus*), the ring-billed gull (*Larus delawarensis*), and the black tern (*Hydrochelidon nigra surinamensis*). The latter lives and breeds about marshes where there is often little or no open water.

An illustration of the value of gulls as insect destroyers is furnished by the experience of the Mormons when they settled in Utah and raised their first crops of grain. This is graphically described by Hon. Geo. A. Cannon, temporary chairman of the Third Irrigation Congress:

Black crickets came down by millions and destroyed our grain crops; promising fields of wheat in the morning were in the evening as smooth as a man's hand—devoured by the crickets. At this juncture sea gulls [California gulls] came by hundreds and thousands, and before the crops were entirely destroyed these gulls devoured the

insects, so that our fields were entirely freed from them. The settlers at Salt Lake regarded the advent of the birds as a heaven-sent miracle. * * * I have been along the ditches in the morning and have seen lumps of these crickets vomited up by these gulls, so that they could again begin killing.

These "lumps of crickets" were undoubtedly "pellets" of the indigestible parts habitually disgorged by the birds. At the time of the Nevada mouse plague in Humboldt Valley in 1907, gulls, as well as hawks and owls, were noted feasting on the destructive rodents.—F. E. L. B.

TERNS.

Like the gulls, terns are usually associated in the mind with the seacoast, but at least six species breed in the interior of the continent. The terns are expert in flight, and so trim and graceful in appearance that they have received the name sea swallows. They breed in colonies, usually nesting on low islands. This leads to the destruction of large numbers of eggs and young by high tides. Formerly terns were slaughtered for millinery purposes to such an extent that some species have been almost extirpated.

Persons engaged in the plumage business have made the not disinterested charge that terns devour large numbers of food fishes and hence should be destroyed. In order to ascertain the truth of the matter the Biological Survey has made a thorough examination of the question. Too few stomachs of the caspian, roseate, and arctic terns have been examined to form a basis for satisfactory conclusions, but a fair number of stomachs of five other species were available—the royal tern, Forster's tern, common tern, least tern, and black tern.

Royal tern (*Sterna maxima*).—Twenty-four stomachs were examined. They contained 3 per cent of crustacea and 97 per cent of fish. The fishes were yellow perch (*Perca flavescens*), 4 per cent, taken in North Carolina in July; bluefish (*Pomatomus saltatrix*), 8 per cent, taken in Florida in March; menhaden (*Brevoortia tyrannus*), 65 per cent, taken in Georgia in November and December, Alabama in October, and Florida in February, August, October, November, and December; and unidentified fishes, 20 per cent.

Thus it is probable that not more than 16 per cent of the normal food consists of fishes eaten by man. The feeding upon menhaden, tons of which are made into fertilizer, is insignificant economically.

Forster's tern (*Sterna forsteri*).—The food of 34 specimens of this species consisted of crustacea, 2 per cent, and fish, 98 per cent. The largest item of finny food was menhaden (*Brevoortia tyrannus*), 28.2 per cent, found in stomachs taken in South Carolina, Georgia, and Florida in November, December, and January, respectively. Silvery anchovies (*Stolephorus*) (not the anchovies of commerce),

forming 24.1 per cent, were next in rank. They were taken in California in September and December, and in Georgia and Florida in November, December, and January. Fresh-water minnows (*Cyprinidae*) composed 20.5 per cent of the food. Following these in importance were pompanos (*Trachinotus carolinus*), 5.9 per cent; round herrings (*Etrumeus sadina*), 5.8 per cent; mummichogs (*Fundulus zebrinus*) and fresh-water sticklebacks (*Eucalia inconstans*), 2.6 per cent each. Unidentified fish made up 7.3 per cent of the food.

Thus only 5.9 per cent of the food of Forster's tern, as at present known, consists of food fishes; 92 per cent consists of fishes of no direct value to man, among which are sticklebacks, which feed upon the spawn of other fishes.

Common tern (*Sterna hirundo*).—One hundred and sixteen stomachs of the common tern (fig. 9) have been examined. One per cent of their food consists of mollusks, crusta-

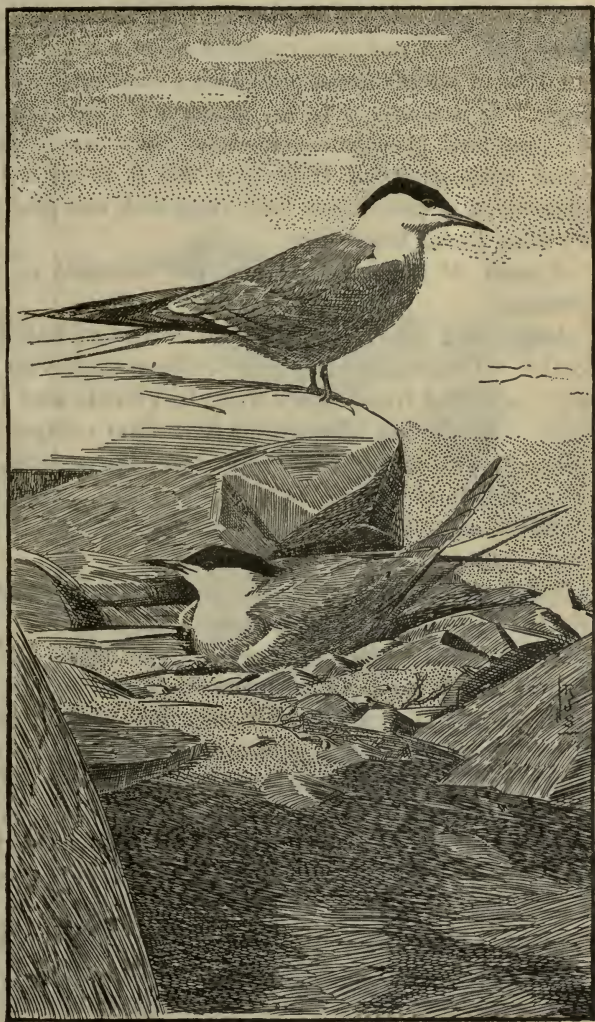


FIG. 9.—Common tern.

cea, and the worms (*Nereis*) which feed upon oysters. Two per cent is composed of moths and 1.5 per cent of other insects, including grasshoppers, crickets, ants, dragon flies, caddis flies, beetles, and bugs. The remaining 95.5 per cent consists of fishes. The largest

item is fresh-water minnows (*Cyprinidæ*), 23.3 per cent. Sand launces (*Ammodytes americanus*) make 17.8 per cent of the food. Other fishes eaten are menhaden (*Brevoortia tyrannus*), 5.1 per cent; yellow perch (*Perca flavescens*) and sticklebacks (*Gasterosteus bispinosus*), 4.3 per cent each; and silvery anchovies (*Stolephorus*), chub mackerel (*Scomber colias*), and silversides (*Menidia*), 1 per cent each.

Only 6 per cent of the bird's food is composed of food fishes. To offset this, 3.5 per cent consists of insects, mostly injurious, and 4.3 per cent of sticklebacks, of which a distinguished naturalist (Günther) says: "It is scarcely to be conceived what damage these little fishes do, and how greatly detrimental they are to the increase of all the fishes among which they live, for it is with the utmost industry, sagacity, and greediness that they seek out and destroy all the young fry that come their way."

Almost 85 per cent of the food consists of fishes of neutral importance.

Least tern (*Sterna antillarum*).—Almost half (43.1 per cent) of the food of 49 least terns consists of silver anchovies (*Stolephorus*). They were captured from New Jersey to Florida and Louisiana in May and June. Menhaden (*Brevoortia tyrannus*) compose 6.8 per cent; mummichogs (*Fundulus*), 6.3 per cent; silversides (*Menidia*), 1.1 per cent; and unidentified fish, 37.7 per cent. The remaining 5 per cent of the food is made up of crustacea. No food fishes were identified from stomachs of the least tern.

Black tern (*Hydrochelidon nigra surinamensis*).—The food of the black tern (fig. 10) is more varied than that of any other species. Fish, chiefly minnows (*Cyprinidæ*) and mummichogs (*Fundulus*), compose a little more than 19 per cent of the total contents of 145 stomachs. Dragon flies make more than 20 per cent; May flies, 13 per cent; grasshoppers, 12 per cent; predaceous diving beetles, almost 6 per cent; scarabæid beetles, almost 5 per cent; leaf beetles, 3½ per cent; gnats and other flies, more than 8 per cent; crustacea, 3½ per cent. Other items of food are ground-beetles (*Carabidæ*), click beetles (*Elateridæ*), weevils, stone flies, caddis flies, water striders, moths, and ants.

The bird preys upon no food fishes, as far as known, but does feed extensively upon such fish enemies as dragon-fly nymphs, dytiscid beetles, and crawfishes. It takes a great variety of insects, including some of economic importance, as the moth of the cotton bollworm and the fall army worm, click beetles (adults of wireworms), weevils, and grasshoppers.

Summary.—The average percentage of food fishes in the regimen of these five species of terns is only 4.8 per cent. This refutes the charge that they live largely on food fishes. Among the other fishes

eaten, menhaden are prominent, forming an average of 21 per cent of the food. Since these fish are so enormously abundant that their chief economic value is for fertilizer and oil, hundreds of tons of which are made, the number of them consumed by terns is insignificant. Silvery anchovies (*Stolephorus*) and fresh water minnows (*Cyprinidæ*) compose about 13 per cent each. These little fishes swarm in shallow waters and are of no direct value to man.

The charge that terns prevent the increase of food fishes by eating the small fishes which are their natural food is wholly unfounded, since there is no scarcity in the food supply, but on the contrary a constant superabundance. In this connection we would point out that some largely herbivorous food fishes, such as the buffalo fishes, with whose food supply the terns have very little to do, have alarmingly decreased, just as have some of the carnivorous ones. The cause of reduction in the number of food fishes is not chiefly failure of the natural food supply, but, as has been pointed out by experts of the United States Bureau of Fisheries, too close fishing.

The responsibility for the scarcity of certain food fishes, therefore, can not justly be placed upon the terns, especially since it is shown that a very small proportion of their diet is composed of these fishes.



FIG. 10.—Black tern.

Moreover, it must be remembered to their credit that part of their food consists of economically injurious fishes, and that in the case of some species a considerable proportion of insects is taken, most of which are directly injurious to the fishing industry.—W. L. M.

COOPER'S HAWK.

(*Accipiter cooperi*.)

Cooper's hawk (fig. 11) may be taken as a type of the group of hawks whose habits are responsible for the condemnation of birds of prey as a whole. This group includes three species: Cooper's hawk,



FIG. 11.—Cooper's Hawk.

the sharp-shinned hawk, and the goshawk. They are often spoken of as blue darters, a name which expresses a characteristic difference in their manner of hunting from that of other hawks. They course over the country at great speed and capture their prey by sudden darts. The blue darters are long-tailed hawks, but they should not be confounded with that other conspicuously long-tailed bird, the marsh hawk. The latter usually flies

slowly and may be recognized by the white rump. The red-tailed, red-shouldered, and other large hawks usually watch for their prey from some convenient lookout station or soar slowly over meadow and forest, watching a chance to pounce upon their quarry. These hawks almost always seize their victims on the ground, while hawks of the darter group often take them in full flight. This difference is of course chiefly due to the character of the prey, the darters feeding almost exclusively upon birds, which usually must be caught on the wing, while the other hawks prey upon

mice and other small mammals, snakes, and grasshoppers and other insects, which as a rule must be sought on the ground.

Cooper's hawk, which occurs throughout the United States, is pre-eminently a "chicken hawk," and it is by far the most destructive species we have to contend with, not because it is individually worse than the goshawk, but because it is so much more numerous that the aggregate damage done far exceeds that of all other birds of prey. It is strong enough to carry away a good-sized chicken, grouse, or cottontail rabbit. It is especially fond of domesticated doves and when it finds a cote easy of approach it usually takes a toll of one or two a day. Practically every stomach of Cooper's hawk examined contained remains of wild birds or poultry.—
W. L. M.

THE ROUGH-LEGGED HAWK.

(*Archibuteo lagopus sancti-johannis.*)

The rough-legged hawk (fig. 12), whose range, in general terms, is North America north of Mexico, is a representative of the class of almost wholly beneficial hawks. In regard to its habits Dr. Fisher says:

The rough-leg is one of the most nocturnal of our hawks, and may be seen in the fading twilight watching from some low perch, or beating with measured, noiseless flight,



FIG. 12.—Rough-legged hawk.

over its hunting ground. It follows two very different methods in securing its food, one by sitting on some stub or low tree and watching the ground for the appearance of its prey, as the red tail does; the other by beating back and forth just above the tops of the grass or bushes, and dropping upon its victim after the manner of the marsh hawk. Its food consists principally, if not almost exclusively, of the smaller rodents, and most prominent among these are the arvicoline mice and lemmings. As is well known, the meadow mice (*Arvicolæ*) are widely distributed over the north temperate zone, and often occur in immense numbers, overrunning certain sections of country, and doing irreparable damage to crops as well as to fruit and ornamental trees. Repeatedly young orchards, consisting of hundreds of trees, and representing great

money value, have been totally destroyed by these pests. The damage is done in winter, under the snow, where the mice eat the bark from the trees, often completely girdling them and causing death. Usually meadow mice are fairly common if not abundant over a large part of the meadow and marsh lands of the central and northern United States and temperate Canada. To show how important meadow mice are to the rough leg as an article of food, it may be stated in general terms that the southern limit of its wandering in winter is nearly coincident with the southern boundary of the region inhabited by meadow mice. In the north lemmings are abundant over



FIG. 13.—Sparrow hawk.

the country in which the rough leg makes its summer home, and furnish a never-failing supply of food for old and young.¹

Meadow mice were found in 28 stomachs, 5 or 6 occurring in several, and as many as 12 in 1. A few rats, house mice, shrews, and other small mammals also were found, birds appearing in only 3 stomachs.—W. L. M.

SPARROW HAWK.

(*Falco sparverius*.)

The sparrow hawk (fig. 13) ranges over almost the whole of North America. It is the smallest as well as one of the handsomest of our hawks and one of the best known. It is further distinguished by its

¹ Bull. 3, Biological Survey, p. 87, 1893.

swallowlike flight, its habit of hovering over the luckless grasshopper or meadow mouse it hopes to make a meal of, and its repeated shrill wavering cry. "It is the only one of the true falcons," as has been pointed out by Dr. Fisher, "which can be placed in the mainly beneficial class." He says further:

At times it attacks small birds and young chickens, but these irregularities are so infrequent that they are more than outweighed by its good services in destroying insects and mice. Grasshoppers, crickets, and other insects form its principal food during the warm months, while mice predominate during the rest of the year. Terrestrial caterpillars, beetles, and spiders also are eaten to a considerable extent. As might be expected, a large proportion of the birds captured are taken during the nesting season, the hawks then having less time to secure their favorite food. It is at this time also that they commit depredations in poultry yards. During late fall and winter, meadow mice and house mice form a large part of their food, the former being taken in fields and meadows and the latter around corn stacks and about barns and outbuildings. Because of its confidence and lack of fear the sparrow hawk is one of the species which suffers most from unjust bounty laws. Any vandal who can carry a gun is able to slaughter this little hawk. Mr. W. B. Hall, of Wakeman, Ohio, writes us that while the hawk law was in force in Ohio he was township clerk in his native village and issued 86 certificates, 46 being for sparrow hawks. He examined the stomachs and found 45 of them to contain the remains of grasshoppers and beetles, while the remaining one contained the fur and bones of a meadow mouse.¹

W. L. M.

LONG-EARED OWL.

(*Asio wilsonianus*.)

The long-eared owl occurs throughout the United States. It is nocturnal in its habits and is one of our most beneficial species. Mice, principally meadow mice, are its staple food. One hundred and fifty pellets collected by Dr. Fisher under the roost of a bird of this species at Munson Hill, Va., contained remains of 95 meadow mice, 19 pine mice, 15 house mice, 5 white-footed mice, 3 Cooper's mice, 26 shrews, and 13 birds, of which 11 were sparrows, 1 a bluebird, and the other a warbler. Eighty-six out of 92 stomachs examined also contained mice. The bird is common all over the United States and does a great deal of good. It is not wary, hence is one of the greatest sufferers where bounties are paid for the destruction of birds of prey.—W. L. M.

SCREECH OWL.

(*Otus asio*.)

The little screech owl (fig. 14), in the South aptly called "shivering owl," in allusion to its quavering whistle, or perhaps to the effect of that call upon the listener, ranges from coast to coast and far beyond both the northern and southern boundaries of the United States. With the exception of the burrowing owl it feeds more

¹ Circ. 61, Biological Survey, p. 9, 1907.

extensively on insects than any of the other owls. It is also, according to Dr. Fisher—

a diligent mouser, and feeds more or less on crawfish, frogs, toads, scorpions, lizards, and fish. * * *

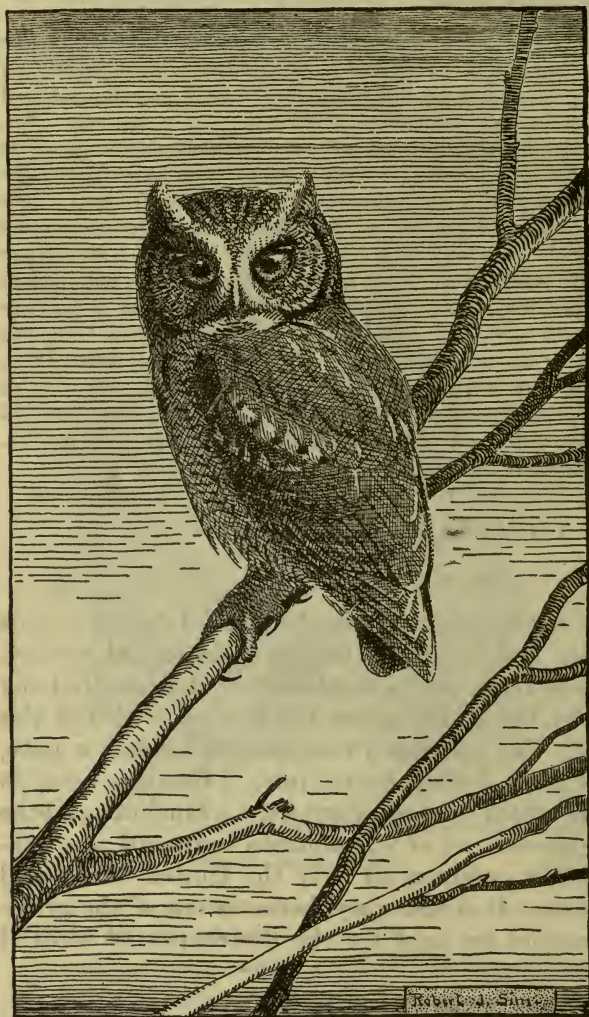


FIG. 14.—Screech owl.

English sparrows), there is no question that this little owl should be carefully protected.¹

W. L. M.

are most often eaten. As many as 50 grasshoppers have been found in one stomach, 18 May beetles in another, and 13 cutworms in another. During the warmer parts of the year it is exceptional to find a stomach not well filled with insect remains. Meadow mice, white-footed mice, and house mice are the mammals most often taken, while chipmunks, wood rats, flying squirrels, and moles are less frequently found. The screech owl is fond of fish and catches many, especially in winter, when he watches near the breathing holes in the ice, and seizes the luckless fish which comes to the surface. Most of the birds destroyed by this owl are killed either in severe winter weather or during the breeding season, when it has hard work to feed its young. As nearly three-fourths of the owl's food consists of injurious mammals and insects, and only about one-seventh of birds (a large proportion of which are destructive

¹ Circ. 61, Biological Survey, pp. 12-13, 1907.



BULLETIN OF THE U.S. DEPARTMENT OF AGRICULTURE



No. 58

Contribution from the Bureau of Biological Survey, Henry W. Henshaw, Chief.

February 7, 1914.

FIVE IMPORTANT WILD-DUCK FOODS.

By W. L. MCATEE, *Assistant Biologist.*

Numerous requests for Circular No. 81, containing information on the value, appearance, distribution, and propagation of three important wild-duck foods, namely, wild rice, wild celery, and pondweeds, attest the widespread demand for knowledge about plants attractive to wild fowl. The data gathered by the Biological Survey relating to duck-food plants has been widely used by State game commissions, game protective associations, and individuals interested in the protection, preservation, and propagation of our native species of ducks and geese. To make available further information of this nature the present account has been prepared, which treats of five other plants of great intrinsic value. Though at present of local importance, all of them are suitable for propagation over most of the United States, and there is no reason why they should not be introduced and take rank among the staple foods of wild ducks in many localities where now unknown.

DELTA DUCK POTATO.

VALUE AS DUCK FOOD.

In the latter part of January and early February, 1910, the writer, under authorization of the Biological Survey, visited the Mississippi Delta, La. One of the principal objects of this trip was to find out what it is that attracts large numbers of canvasbacks to this shoal-water region, the shallow ponds and lakes of which are so different from the comparatively deep water bodies frequented by canvasbacks in the northern States. The attraction was found to be a species of *Sagittaria* (*S. platyphylla*), which is known to the hunters of this and other parts of Louisiana as wild potato or wild onion. From an examination of a large number of stomachs it was found that about 70 per cent of the food of the canvasbacks collected consisted of the tubers of this plant, as did also more than 65 per cent of the food of the mallards. The pintail also was found to feed upon the tubers. The gullet of one canvasback was filled to the throat with the duck potatoes, 24 entire ones being present, besides ground-up remains of several others. Other individuals had 14 to 17 of the tubers in their gullets. There is no doubt that *Sagittaria platyphylla* is an impor-

tant food for the larger species of ducks not only in the Mississippi Delta but throughout the whole range of the plant.

DESCRIPTION OF PLANT.

The Delta duck potato (fig. 1) when well developed stands about 18 inches above the soil. The broadly elliptical leaves have a char-



FIG. 1.—Delta duck potato. (Scale is 18 inches long.)

acteristic firm appearance and a beautiful clear green color. Like all plants of its genus, this species produces the flowering peduncles from about the center of the group of leafstalks; these peduncles bear

flowers in whorls of three, and the individual flowers each have three white petals and a yellow center. The petals soon fall and the small green balls of immature seeds remain. These enlarge during the summer, and when ripe are brown and nearly half an inch in diameter. They are easily crushed, separating into hundreds of thin triangular seeds.

The tubers are of irregular globular shape and vary up to an inch in diameter. They are formed at the ends of runners (thicker than the roots) and bear on the side opposite the attachment to the runner a scale-sheathed bud which may be an inch or more in length. Run-



FIG. 2.—Tubers of the delta duck potato. (About two-thirds natural size.)

ning around the body of the tuber are two or three darker lines from which originate fibrous sheaths. A glance at the illustration of the tubers (fig. 2) of this species shows the aptness of the name wild potato. It should be explained, however, that normally the tubers would be more widely separated than is the case with those on this particular specimen, which was grown in a flower pot.

DISTRIBUTION.

In ancient times the Mississippi River emptied into a vast bay which extended at least as far north as the region now known as

southern Illinois. Its actively growing delta (which is still apparently in full vigor) made thick deposits of silt over some thousands of square miles of this area while the remainder was being slowly elevated. *Sagittaria platyphylla* is so nearly confined in its distribution to this ancient basin, and is so characteristic of the present delta, that the name delta duck potato is eminently fitting. The outlying points of the range of the plant as now known are San Antonio, Tex., Lake City, Mo., Chattanooga, Tenn., and Mobile, Ala. (See fig. 3.)

PROPAGATION.

The delta duck potato undoubtedly can be propagated from seed, but all things considered, transplanting the tubers is probably much the better method. This insures a large percentage of success, the

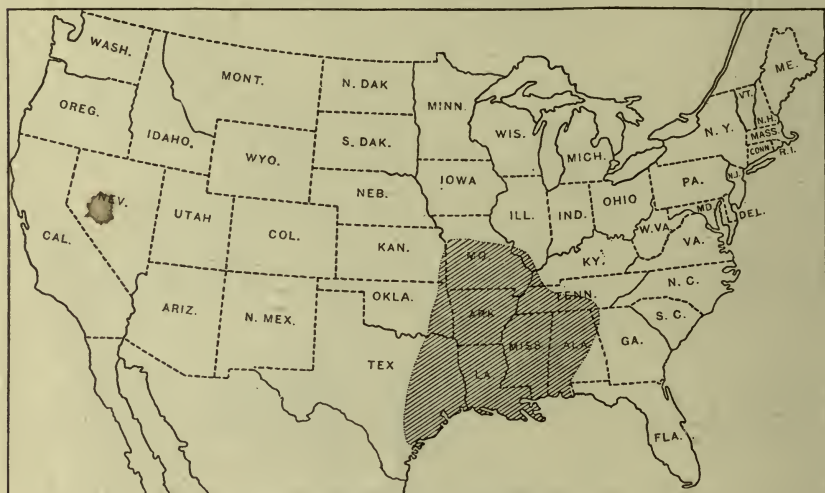


FIG. 3.—Range of the delta duck potato.

plants will be larger, and as they will produce other tubers the first year they are much more valuable. Extraordinary precautions to prevent drying are not necessary, but the tubers should be kept cool and well exposed to the air to prevent heating or fermentation.

To plant, embed the tubers in mud bottom where the water is not more than a foot deep, preferably not more than 6 inches. It is better to err on the shallow side. The plant will grow thriftily on soil never covered by water but which has plenty of moisture. In such situations, however, the tubers are not available to ducks unless overflowed in winter. The delta duck potato is not injured by a slight amount of salt in the soil. The plant is probably hardy anywhere in the southern half of the United States and may prove to be so farther north.

WAPATO.

VALUE AS DUCK FOOD.

The tubers of wapato (*Sagittaria latifolia* and *Sagittaria arifolia*) have been known to white men as an important food for wild fowl since the time of the Lewis and Clark expedition of 1804–1806. These famous explorers state that in the Columbia River Valley large numbers of ducks, geese, and swans occur where this plant is abundant and that the swans in particular feed extensively upon the plant. A correspondent of the Survey, George W. Russell, of Gaston, Oreg., writes that the wapato is fed upon most by the diving ducks, as the canvasback, redhead, and bluebills (scaups), and that they seek it whenever they are present in the country where it grows. Prof. David Dale Owen in his report of a geological survey of Wisconsin, Iowa, and Minnesota notes that these tubers afford much nourishment to the larger aquatic fowls. The vernacular names swan potato and duck potato that have been applied to these plants give further evidence of their value to wild fowl. Other local names are swamp potato, muskrat potato, Chinese onion, and water nut. The Biological

Survey has found various parts of *Sagittaria* plants in stomachs of the following species of waterfowl: Mallard, widgeon, green-winged teal, blue-winged teal, spoonbill, pintail, canvasback, little bluebill, ruddy duck, Canada goose, and whooping swan.

DESCRIPTION OF PLANT.

The general relations of the stems, flowers, and tubers are the same in the wapato (fig. 4) as in the delta duck potato. The shape of the leaves, however, is entirely different. Both *S. latifolia* and *S. arifolia* have arrowhead-shaped leaves. These vary greatly in the length, width, and shape of the point and barbs and in the degree of



FIG. 4.—Young eastern plant of the wapato with single tuber. (Two-thirds natural size:)

divergence of the latter. Various forms of leaves are illustrated by figure 5. The wapato plant sometimes reaches a height of 4 feet. The appearance of the flowers and seed balls is much the same as in the delta duck potato.

The tubers of *S. latifolia* (fig. 6), from six to nine in number per plant, are formed on runners in the same manner as those of the delta duck potato, but they attain a much larger size. The largest specimen examined by the writer is 2 inches in its longest diameter and 1 inch thick. Including the bud and a short stalk at the base, the entire tuber may measure as much as 5 inches in length. The mature tubers of plants from the northwest are more or less flattened, the shape being comparable to that of the ordinary edible crab. The smaller tubers are more nearly spherical (varying to ovoid), and this is the shape of even the largest tubers of eastern plants that the writer has seen. The sheaths of the tuber being of a darker color than the body are conspicuous.



FIG. 5.—Various shapes of wapato leaves. (About one-tenth natural-size.)

DISTRIBUTION.

Sagittaria latifolia is found from the Atlantic to the Pacific coast, its range covering practically the whole United States. Areas from which it apparently has not been reported are peninsular Florida, the southern two-thirds of Louisiana and Texas, New Mexico, Arizona, and southern California. The northern limit of its range is marked by the following localities: Vancouver Island, Saskatchewan River, and southern Ontario and Quebec. *Sagittaria arifolia* is confined to States from Michigan and Kansas westward. Its range is largely included in that of *latifolia*, although it has been collected in New Mexico. The two species are only distinguishable with certainty upon the basis of mature seeds, and for all practical purposes may be considered as one. (See fig. 7.)

PROPAGATION.

Wapato may be transplanted by means of both seeds and tubers, but the latter are the most reliable and give the quickest results. They may be set with the bud just beneath the surface in mud bottom under a foot, or preferably less, of water. The plants will grow in

wet soil, but the tubers are not available for duck food in such places unless overflowed in fall and winter.

The tubers of this plant are known to retain their vitality when dried, but more uniform success will probably be had if drying is not



FIG. 6.—Wapato tubers. (About two-thirds natural size.)

carried to an extreme. We recommend that the tubers be shipped promptly after gathering, in well ventilated packages, and that they be planted immediately upon receipt. Wapato is suitable for cultivation in practically all parts of the United States.

CHUFA.

VALUE AS DUCK FOOD.

Like some of the other duck foods mentioned in this circular, chufas are at present known to be of only local importance. Those best acquainted with conditions at Big Lake, Ark., one of the most famous hunting grounds of the South, believe that the chufa, or nut grass, as it is there called, is the principal element in rendering that lake so attractive to waterfowl. Examination of stomachs from that locality seems to justify this belief. Six out of a series of nine mallards collected at Big Lake in December, 1910, had fed on sedge tubers, the average percentage of which in the total food of the nine

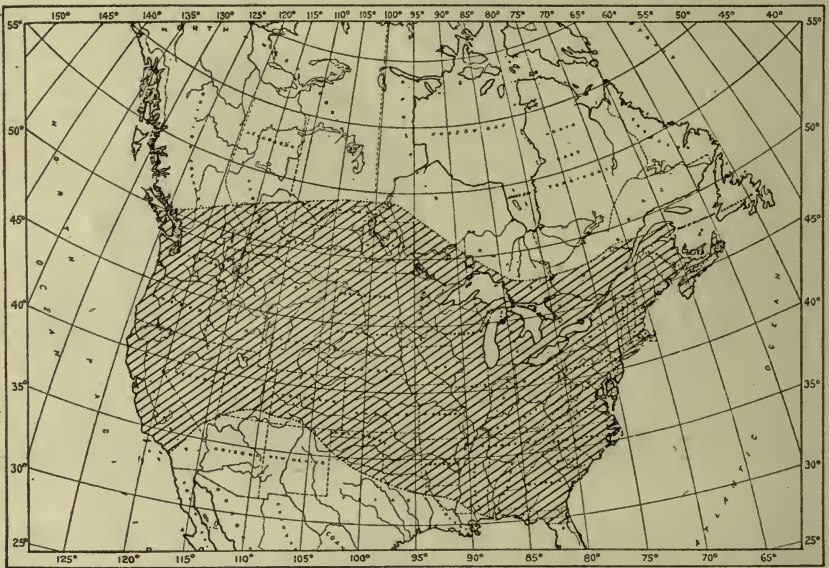


FIG. 7.—Range of the wapato.

was 56. Tubers of this species or others of its genus have been found also in duck stomachs from Florida, Illinois, Minnesota, and California. The species of ducks now known to feed on chufas are the wood duck, mottled duck, mallard, and canvasback.

DESCRIPTION OF PLANT.

The chufa (*Cyperus esculentus*) (fig. 8) belongs to the group of plants known as sedges. These are grass-like and usually classed with the grasses by nonbotanists. Many of the sedges, however, including the chufa, have triangular, not round, stalks. The members of the genus *Cyperus* have a group of leaves at the base from which rises the stalk bearing the flowers and seeds. In the chufa these stalks are from 1 to 3 feet high. Several flower clusters on peduncles of

varying length rise from the top of the stalk. From the same point three rather long grass-like leaves project below the fruiting clusters.

Many members of the genus have a very similar appearance and it is not expected that nonbotanical observers can distinguish them. This is unnecessary, however, as tubers of the chufa for



FIG. 8.—Seed-bearing and immature plants of the chufa. (Much reduced.)

propagation may be obtained from most seedsmen. The tubers of the chufa are formed at the ends of scale-covered rootstocks. The plant is extremely prolific, cultivated forms usually producing 100 tubers to the plant, and instances are known in which more than 600 tubers were produced in one season from one tuber planted in the spring.

Well-developed tubers of the cultivated variety average about three-fourths of an inch in length by three-eighths of an inch in diameter when dried. Tubers from wild plants are usually much smaller and have a greater proportion of fiber. The general appearance of chufas and of tubers from a wild sedge are well shown by figure 9.

Chufas are known also by the vernacular names, earth almonds and ground nuts, and the plant as nut grass and cache-cache.



FIG. 9.—Tubers of wild *Cyperus* and cultivated chufas. (Natural size.)

DISTRIBUTION.

The northern boundary of the natural range of the chufa is marked by the following localities: Southern New Brunswick, southern Ontario, northern Nebraska, New Mexico, Arizona, and the Columbia River Valley. The plant seems to be absent from most of the Great Basin and Rocky Mountain regions. From the northern line specified the plant ranges southward over the remainder of the continent. (See fig. 10.) It is widely distributed in warm climates over the entire world.

PROPAGATION.

Although the chufa seems not to grow naturally in a large area in the western United States, there is no doubt that it can be cultivated everywhere except in the higher parts of the Rocky Mountain region. It is said to do fairly well at the altitude of Denver.

Chufas can be obtained from most seedsmen and are so cheap that it will pay sportsmen to buy new stock every few years, if earlier plantings show degeneration in size of the tubers and hence reduction in value as duck food. Chufas do best on light or somewhat sandy but rich soils. They are only available for duck food when planted



FIG. 10.—Range of the chufa.

on land dry in summer and overflowed in winter. In the open they should be planted thickly so as to give the plants a better chance in competition with weeds. In timbered land they need not be planted so thickly, but they will do well only in rather sparse growths, where considerable light penetrates to the ground. When possible the land where planting is intended should be broken up and freed from weeds. Plant the tubers just beneath the surface in spring.

WILD MILLET.

VALUE AS DUCK FOOD.

Wild millet (*Echinochloa crus-galli*) is an important food for ducks in widely separated regions of the United States. At Mud Lake,

Ark., the writer found seeds of this plant to constitute more than 10 per cent of the food of the 41 mallards collected; at Belle Isle, La., it made up more than half of the food of the few mallards examined, and at Cameron, La., over 75 per cent of the diet of a collection of 50 ducks of the same species. Pintails, teal, and other shoal-water ducks are almost equally fond of it. Geese eat the stems and leaves of the plant, as also do ducks when they are hard pressed. Testimony as to the value of the plant has come from Wisconsin and Oregon, and the Biological Survey has found seeds of wild millet in duck stomachs from Massachusetts, South Dakota, Missouri, and Nebraska in addition to the States above mentioned.

The plant is popularly known throughout lower Louisiana as wild rice and is given about the same rank as a duck food as the plant (*Zizania aquatica*) known by that name in the north. Other popular names referring to the preference of wild fowl for the plant are goose grass and blue duck food.

DESCRIPTION OF PLANT.

Wild millet is a coarse, leafy grass which grows from 1 to 6 feet in height. The stems and foliage are not especially remarkable, but the fruiting head has characters which enable us easily to distinguish this from other species of native grasses. The chaff or outer seed coverings is set with rows of short, stiff, outstanding spines. These project beyond the general outline of the body of the seeds and give them an easily visible spiny appearance (fig. 11). The inner scale of the chaff terminates in a spine which is always stouter and longer than the others. This spine or awn may be very short or it may be from 2 to 3 inches long or more, surpassing by many times the length of the seed. One of the other scales also may bear a long spine at the tip. The prickly character of the seed coverings is referred to in the name cockspur grass. The longer awns in particular and sometimes the whole fruiting heads may have a deep purplish color. This, no doubt, suggested the name blue duck food used in the Mississippi Delta. The long-awned form has been given the varietal name *longearistata* but for present purposes we may consider all the types illustrated in figures 11 and 12 under the same name. It is probable also that the form named *Echinochloa walteri* is fully connected with *crus-galli* by intergrades, and deserves only varietal rank. This form has the lower or all leaf sheaths rough hispid.

DISTRIBUTION.

The northern limit of the range of wild millet so far as known to us does not much surpass the latitude of the northern boundary of the United States. From there the plant ranges indefinitely to the southward, occurring generally in rich moist soils or swamps at least to Central America.



FIG. 11.—Part of fruiting head of wild millet. (Natural size.)

PROPAGATION.

Wild millet is easily cultivated and reseeds itself. It requires a moist and preferably a rich soil, such as the edge of a marsh or lake, and it will grow in water at least a foot in depth. Break up the soil (mainly for the purpose of discouraging other plant growth) and sow thickly in spring. Once established, the plant will take care of itself. The nearer to water it is planted the more available it will be for duck food. It is a splendid plant to use for low lands that are flooded in winter.

The seeds are sold by most seedsmen under the name barnyard grass. A variety has been widely advertised as Japanese barnyard



FIG. 12.—Fructing heads of wild millet. (One-third natural size.)

millet or billion-dollar grass. The plant is also known as cockspur grass and sour grass. It may be cultivated in any part of the United States having the proper soil conditions.

BANANA WATER LILY.

VALUE AS DUCK FOOD.

The writer has investigated the value of the banana water lily (*Nymphaea mexicana*) as a food for wild ducks in only one locality—Lake Surprise, Tex. The proofs of its importance are so great, however, that they should be brought to the attention of American sportsmen. At Lake Surprise the banana water lily alone made up

nearly half of the entire food of the 10 vegetarian species of ducks occurring there at the time. This showing is much more significant from the fact that sago pond weed (*Potamogeton pectinatus*) also was abundant in the lake. The latter plant, in the writer's opinion, is the best all-round duck food¹ in North America, yet at Lake Surprise it furnished somewhat less than 29 per cent of the food of the ducks in comparison with more than 48 per cent supplied by *Nymphæa mexicana*.

Thirty-seven canvasbacks collected at Lake Surprise had eaten various parts of this plant to the extent of 71.6 per cent of their diet. This is a second illustration of the unusual phenomenon of the canvasback's being attracted to shallow water by a highly prized food. Six ring-necked ducks or blackjacks made more than 91 per cent of their food of this plant, and two southern black ducks (*Anas fulvigula*) 98 per cent. The parts eaten are the rootstocks, stolons, tubers, and seeds. Mr. Charles W. Ward has sent us rootstocks of *Nymphæa mexicana* from Avery Island, La., with the information that this plant and wild celery (*Vallisneria spiralis*) furnish the bulk of the food of canvasbacks in that locality.

DESCRIPTION OF PLANT.

For the purposes of field identification the water lilies of the United States may be divided primarily into two groups according to the shape of the leaf. Two genera, the water shield (*Brasenia*)² and the American lotus, or water chinkapin (*Nelumbo*),² have entire circular leaves with the leaf stalks attached at their centers. The remaining two genera have more or less heart-shaped leaves or a circular or oval leaf with a cleft or sinus from the edge to the point of attachment of the leaf stalk. Of these two genera, one (*Nuphar*),² including the spatterdocks or toad lilies, has the top or more of the ovary plainly visible when in flower, the other has the ovary practically hidden by the very numerous stamens. To this last group belongs *Nymphæa mexicana*, and it is the only native species of the genus that has yellow flowers.

Both the leaves and flowers of this species may either float on the surface of the water or stand a few inches above it. The leaves are green above with brown mottlings and vary from greenish to purplish red below with small black markings. The edges of the cleft of the leaf are either somewhat separated or overlapping (fig. 13). The plant springs from an upright rootstock (fig. 14) which bears some resemblance to an unopened pine cone. The rootstocks vary in size up to 2 inches in thickness and 12 inches in length. The smaller ones (at least up to 1 $\frac{3}{4}$ inches in length by three-fourths of an inch in thickness) are swallowed by ducks.

¹ See Biological Survey Circular 81, pp. 11-17, for full account.

² The seeds, at least, of all these plants are eaten by many kinds of ducks.

Tender white stolons or runners extend in various directions from the rootstock. These runners are from a quarter to half an inch in diameter. During the active growing season they give rise to new plants, but in autumn they form peculiar hibernating bodies. These consist of the short modified tip of the stolon, which bears several (1-7) upwardly-directed buds on one side and a cluster (2-17) of thick tuberlike roots on the other. The appearance of these (fig. 15) is strongly suggestive of a miniature "hand" of bananas, and for this reason the name banana water lily is proposed for this plant, which

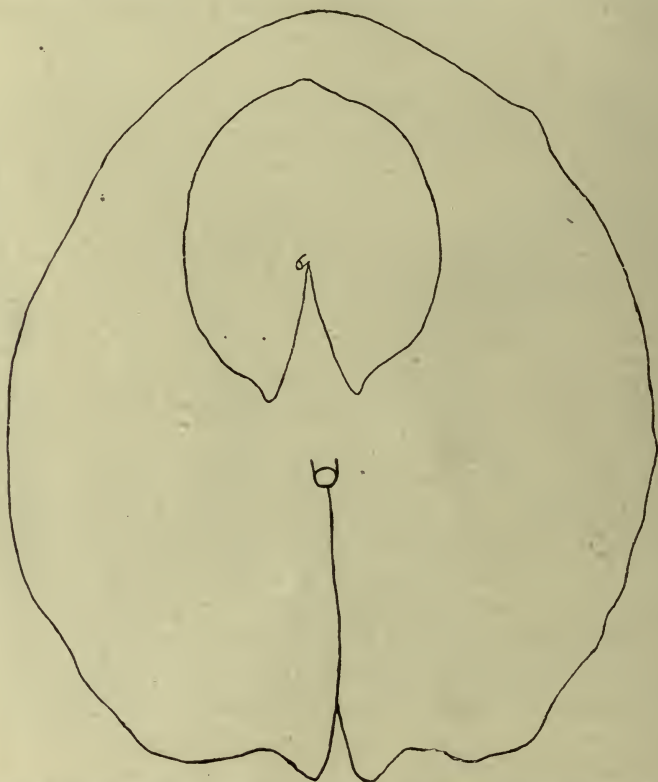


FIG. 13.—Two types of leaves of the banana water lily. (The larger outline half natural size.)

at present has no distinctive vernacular appellation. The name has the additional merit of suggesting the yellow color of the tubers and of the flowers.

DISTRIBUTION.

The banana water lily has been known chiefly as a native of Florida and the plants of that State have long gone under the name *Nymphaea flava*. Plants identified from a few localities in Mexico and from Brownsville, Tex., have been called *N. mexicana*. Dr. H. S. Conard, who has monographed the genus,¹ unites these species, as he

¹ Publication No. 4, Carnegie Institution, 1905.

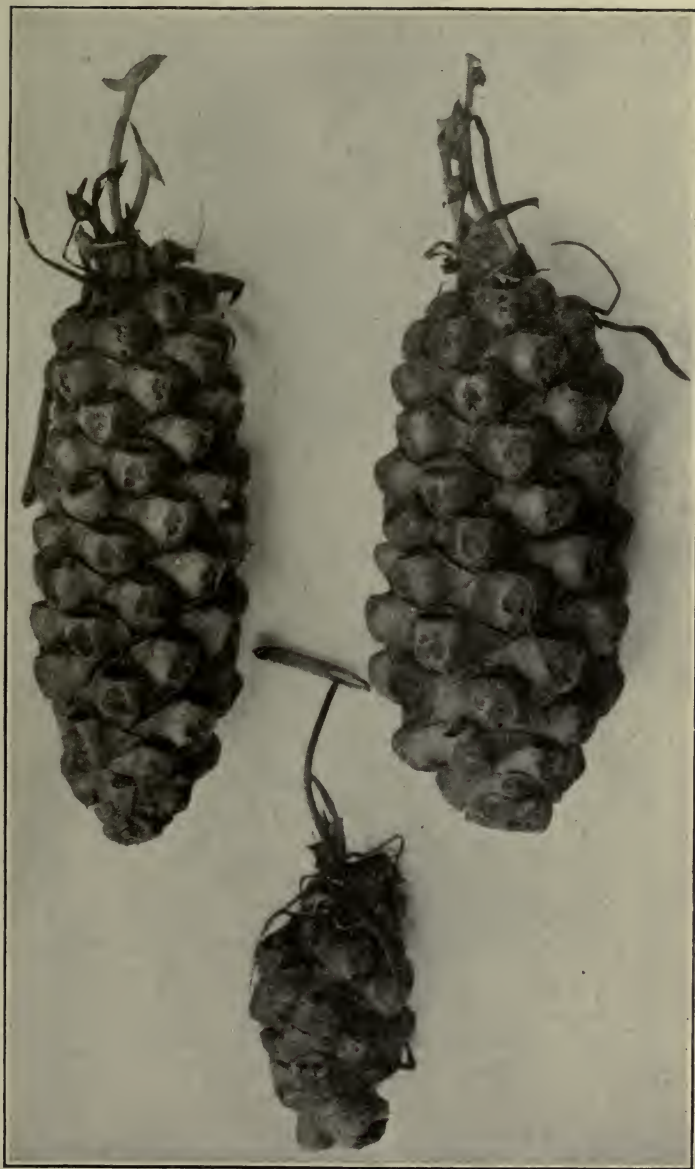


FIG. 14.—Small rootstocks of the banana water lily. (Natural size.)

is fully justified in doing on the basis of their possession in common of characters unique among water lilies. The new records of the plant from Galveston, Tex., and Avery Island, La., go far toward bridging



FIG. 15.—Hibernating bodies of the banana water lily. (Two-thirds natural size.)

the previous apparent gap in distribution of the plant and to corroborating Dr. Conard's views. The accompanying map (fig. 16) shows the probable natural range of the species.



FIG. 16.—Range of the banana water lily.

PROPAGATION.

Although the banana water lily is native to only a small portion of the United States, it can be successfully grown over practically the whole country. The plant has long been familiar in cultivation and is sold by most dealers in ornamental aquatics. The water lily expert of one of the largest firms in the United States has informed us that

Nymphæa mexicana is perfectly hardy as far north as New York City when covered with a foot of water and he believes that if covered with 2 feet of water it would be hardy at Boston.

The banana water lily needs an abundance of sunlight, water from 1 to 3 feet deep,¹ and a mud bottom. It is not injured by a trace of salt, as is shown by its growing in lakes very near the coast. The rootstocks may be planted by weighting them with stones and dropping where desired. They have great vitality; they may be shipped with only moderate precautions to prevent them from drying, and may be transplanted at almost any time of the year.

¹ When established it will spread to places where the water is even 5 feet deep.

ADDITIONAL COPIES of this publication
may be procured from the SUPERINTEND-
ENT OF DOCUMENTS, Government Printing
Office, Washington, D. C., at 5 cents per copy.



Y. B. Separate 557.

K

OUR MID-PACIFIC BIRD RESERVATION.

BY

HENRY W. HENSHAW,
Chief, Bureau of Biological Survey.

[FROM YEARBOOK OF DEPARTMENT OF AGRICULTURE FOR 1911.]

CONTENTS.

	Page.
The need for bird reservations	155
Number of bird reservations	155
Birds as carriers of seeds	156
Rabbits as a menace to vegetation	157
The Nutting expedition of 1911	157
History of Laysan Island	158
Description of Laysan Island	158
The land birds of Laysan Island	160
The sea birds of Laysan Island	161
Ravages of plume hunters	163
Protection essential to preservation of reservation and species	164

ILLUSTRATIONS.

PLATES.

	Page.
PLATE I. Fig. 1.—Laysan albatrosses dancing. Fig. 2.—Nesting colony of Laysan albatrosses	158
II. Fig. 1.—Man-o'-war birds nesting, Laysan Island. Fig. 2.—Colony of gray-backed terns, Laysan Island	158

TEXT FIGURES.

Fig. 1.—Hawaiian Islands Reservation for protection of native birds	156
2.—Bird rookeries of Laysan Island	159

OUR MID-PACIFIC BIRD RESERVATION.

By HENRY W. HENSHAW,
Chief, Bureau of Biological Survey.

THE NEED FOR BIRD RESERVATIONS.

The spread of civilization and the utilization of wild lands, added to the destruction of animals for food, adornment, clothing, and sport, threaten the very existence of many species of native birds and mammals. The necessity of regulating the killing of game was perceived early in our colonial history, and even the need of caring for our insectivorous birds found recognition about 1850. Only in comparatively recent years, however, has the importance been recognized of protecting the large class of birds which, although they do not destroy insects or other creatures inimical to agricultural interests, are nevertheless worthy of preservation because of their beauty, grace, and harmlessness. If such birds add nothing to our material wealth, they beautify the world and greatly increase the joy of living.

Though by no means the first to recognize the importance of protecting its wild life, the United States has taken a leading place among the nations of the world in this respect. One of the most efficient of the conservation measures adopted by the Government is the setting apart here and there of islands and sterile tracts of land, worthless for other purposes, upon which our native wild birds and mammals may live and perpetuate their kind for the pleasure and profit of our own and future generations.

NUMBER OF BIRD RESERVATIONS.

The National bird reservations under the care of the Department of Agriculture already number 51 and play a very important part in the preservation of our wild game and birds. One of the most unique and interesting of these is the Hawaiian Islands Bird Reservation in the mid-Pacific (fig. 1), which, at certain seasons of the year, harbors millions of sea fowls that repair thither to establish rookeries and rear their young. The following is the executive order setting apart this refuge:

EXECUTIVE ORDER No. 1019.

It is hereby ordered that the following islets and reefs, namely: Cure Island, Pearl and Hermes Reef, Lysianski or Pell Island, Laysan Island, Mary Reef, Dowsetts Reef, Gardiner Island, Two Brothers Reef, French Frigate Shoal, Necker Island, Frost Shoal and Bird Island, situated in the Pacific Ocean at and near the extreme western extension of the Hawaiian Archipelago between latitudes 23° and 29° north, and longitudes 160° and 180° west from Green-

the most important of nature's seed carriers. Viscid and hooked seeds attach to their plumage, or seeds may be carried in smears of earth or mud on feathers, bill, or feet. Such seeds may be transported indefinite distances and, once in a thousand years or so, dropped on soil favorable to growth. The members of the most recent expedition to the island, the Nutting party in 1911, were especially requested to examine carefully all their specimens of Laysan birds for the presence of seeds, and actually found attached to the foot of a Laysan albatross a seed of a species of the bean-caper family, which is generally distributed in the South Sea islands. So far as known the plant does not grow on Laysan, and had this seed chanced to fall in a favorable spot the flora of the island might have been enriched by another species. A still more striking instance of a bird acting as a carrier of seeds was observed several years ago by Mr. Bryan on Marcus Island, where he found no fewer than 40 seeds of a tree of the madder family adhering to the feathers of a shearwater. These and other similar facts show how the flora of oceanic islands may be transported by birds from island to island or from continents to distant shores.

RABBITS AS A MENACE TO VEGETATION.

Unfortunately, rabbits were introduced into Laysan a few years ago, and now they threaten the very existence of the island vegetation. Thus Mr. Bryan reports that many plants abundant at the time of his former visit in 1903 had completely disappeared by 1910. Others, though still living, showed the marks of girdling by the hungry rodents, a sure indication of their impending fate. If found impracticable to exterminate these mischievous mammals, it is hoped so to reduce their numbers as to render them incapable of much harm. The destruction of the island vegetation would be unfortunate for the bird reservation for many reasons, especially as it would end most of the insect life upon which depends the existence of the land birds and greatly reduce the number of breeding sea birds, several species of which nest in bushes or on trees. The shrubbery is necessary also to protect young birds from the rays of the burning sun.

THE NUTTING EXPEDITION OF 1911.

When the Iowa State University requested the cooperation of the Department of Agriculture for the purpose of securing for its museum representative groups of Laysan birds, the opportunity was welcomed, since it enabled the department to obtain an authentic report on the present condition of the avian colonies on the island as a basis for protective measures. The expedition, composed of 5 persons, was organized, though not accompanied, by Prof. C. C. Nutting, and by him placed under the immediate charge of Prof. Homer R. Dill. Prof. William A. Bryan, of the Oahu College,

Honolulu, accompanied the party as a representative of the Department of Agriculture, and his services were particularly valuable, as he was able to compare present conditions with those obtaining at the time of his former visit, 8 years before. The party landed on the island April 24, 1911, and remained until June 5. The present paper is largely the result of the observations made by this expedition.

HISTORY OF LAYSAN ISLAND.

Laysan is the most important island of the group on account of its size, the extent to which it is covered with vegetation, and the fact that it is the only island of the chain which is inhabited by land birds. Its known history is brief. It was named Moller Island in 1828 by Capt. Sanikowitch, after his ship, in ignorance, apparently, of the fact that it had been previously discovered by an American ship. In 1834 a brief account of the island and its birds was published in the Museum Senckenbergianum Abhandlungen by the well-known traveler and ornithologist F. H. von Kittlitz. He never visited the island, but obtained his data from the lips of Dr. C. Isenbeck, ship doctor of the *Moller*, who made a small collection of the island birds. In 1859 Capt. Brooks visited Laysan and in his interesting account reported, among other things, the presence on the island of 5 palm trees 15 feet high. These were probably the same species as the ones on Bird Island and also the one indigenous to the Hawaiian Islands proper (*Pritchardia gaudechaudii*). Schauinsland found only the stumps in 1896, and even these have since disappeared. Capt. Brooks collected 25 species of plants on the island. He also noted the presence on the shores of numbers of logs, drift from the northwest coast of America, more than 2,000 miles away. In 1891 Henry Palmer was sent to the island by Hon. Walter Rothschild and made a collection of its birds. Schauinsland's visit of three months followed in 1896, and his account, published in Ornithologische Monatsberichte in 1899 and in his Drei Monate auf einer Koralleninsel, contains many extremely interesting notes on the island birds. As Schauinsland records 26 species of plants it is evident that the flora of the island had not diminished in the 37 years following Brooks. The visits of Walter K. Fisher and W. A. Bryan followed in 1902 and 1903, and their valuable and interesting accounts bring the ornithological history of the island down to the date of the visit of the party in 1911 under the cooperative direction of the University of Iowa and the Department of Agriculture.

DESCRIPTION OF LAYSAN ISLAND.

Laysan is a raised coral atoll, doubtless on a volcanic base, about 2 miles long by $1\frac{1}{2}$ broad, and in shape has been likened to a shallow platter (fig. 2). Its highest part is toward the north, where its



FIG. 1.—MAN-O'-WAR BIRDS NESTING, LAYSAN ISLAND.



FIG. 2.—COLONY OF GRAY-BACKED TERNS, LAYSAN ISLAND.



FIG. 1.—LAYSAN ALBATROSSES DANCING.



FIG. 2.—NESTING COLONY OF LAYSAN ALBATROSSES.

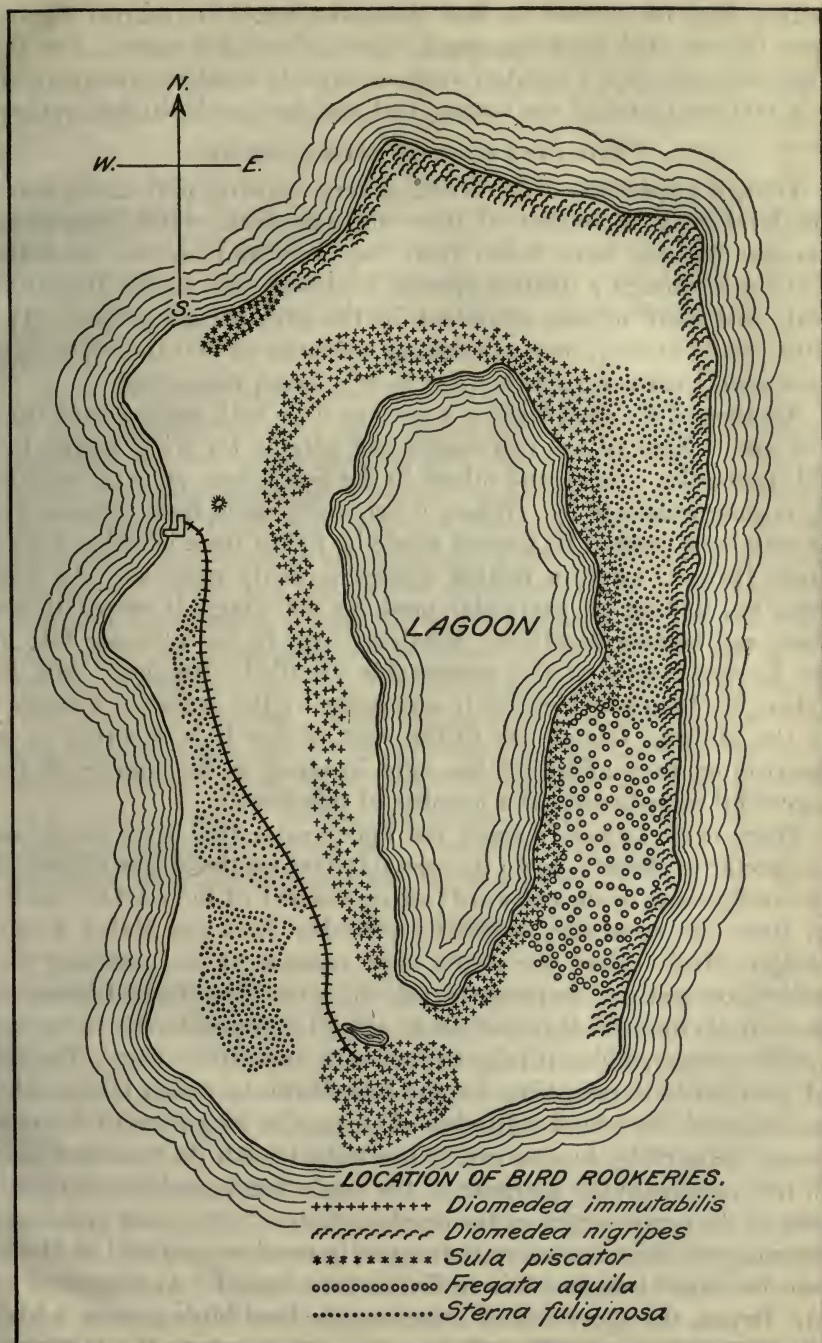


FIG. 2.—Bird rookeries of Laysan Island.

height does not exceed 30 feet above the sea. Its central lagoon, now unconnected with the ocean, covers about 100 acres. Not far from this lagoon is a pond of fresh or slightly brackish water, which is a favorite haunt of the Laysan teal and the bristle-thighed curlew.

THE LAND BIRDS OF LAYSAN ISLAND.

Though apparently not offering a very inviting permanent home for land birds, a number of these and one duck, waifs from more favored regions, have found their way here and become residents. The duck, though a distinct species, is closely akin to the Hawaiian teal, still more or less abundant in the archipelago proper. The little island colony, once numbering upwards of 100 individuals, is now nearly extinct, probably less than a dozen remaining.

Another of the land birds is a curious little rail, smaller even than our sora. None of the rail family are notable for wing power, but this particular species, and others in the South Seas more or less like it, is quite unable to fly. Where it originally came from is unknown. It may have reached its present abode by flying from island to island from Hawaii, where a related species is fairly common. As time went on, finding no particular need for its wings, it ceased to use them and became flightless. Whatever may be the ultimate fate of the Laysan colony of this remarkable so-called "wingless" rail, its future has been provided for in a measure by the export of a number to the Midway Island, far to the west, where it is reported to be flourishing, thus affording the only instance so far known of the successful introduction of a member of this family.

There is on Laysan a small red honey eater that lives chiefly on the nectar of flowers, as do its near relatives on the larger islands of the archipelago to the eastward; also a member of the warbler family of about the same size, originally probably from the Malay Archipelago. It is called the miller bird because of its partiality for millers or moths. Apparently this little warbler finds Laysan so much to its liking that it declines to extend its range to the Hawaiian Islands proper, which it might reach with very little effort. The list of land birds is completed by the Laysan finch, which is the chief musician of the island solitudes. During the long ages of its residence, unheard by human ear, it has trilled forth its beautiful song to the accompanying murmur of the trade winds and the rhythmic beat of the ocean surges on the desolate shore. Some years ago, when unprotected, these finches were trapped in numbers and sold in Honolulu for cage birds, but this traffic has now ceased. As suggested by Mr. Bryan, the above-named insectivorous land birds possess a high economic value and will well repay importation into the Hawaiian Islands proper, thus increasing there the number of insect-eating birds, as well as insuring the future existence of these unique and interesting species.

THE SEA BIRDS OF LAYSAN ISLAND.

But it is as a refuge for sea birds that these islands are chiefly notable. The reefs and waters about Laysan and the other islands fairly teem with fish, crustaceans, squids, and other forms of sea life, thus affording food in abundance for sea fowl, as well as solitude and protection for them and their young. For ages past these ocean wanderers have found the islands an ideal home, and at certain seasons swarmed there, covering every bit of available territory, and all in all forming perhaps the most remarkable bird rookery in the world. On Laysan alone several millions must breed every year.

NESTING.

Not all the birds that resort to this little island could possibly nest on it at one and the same time, and, as the result of ages of experience, each species comes in turn and thus secures room. Even so, however, nesting space has always been at a premium, and Schauinsland, who spent three months on the island in 1896, not inaptly compares the avian domestic arrangements there to a series of flats in a large town. Thus the petrels and shearwaters nest in underground burrows; above them in bushes nest the Laysan finch and the miller bird, while the uppermost accommodations are taken by the boobies and the man-o'-war birds. The breeding season covers practically every month in the year. After biding their time, hither come to nest thousands of terns, petrels, shearwaters, gannets, man-o'-war birds, and albatrosses. In all more than two dozen species of land and sea birds inhabit Laysan during the whole or part of the year. Prof. Dill estimated that at the time of the visit of his party upward of a million of sea birds were nesting on the island. (Pl. I.)

THE ALBATROSS.

Of all the birds that visit or live on Laysan the two species of albatrosses are the most notable. One of these, the black-footed albatross, lives chiefly in the north Pacific, but its range includes our own coast, from Alaska to California, and that of China and Japan. This is the species which is a familiar sight daily to voyagers from San Francisco to Honolulu. When the outward-bound vessel is well off the California coast it is sure to be sighted by a half dozen or more of these black-footed albatrosses (or goonies, as they are known to the sailors), which do not part company with it till near the Hawaiian Islands. The other species, known as the Laysan albatross, is chiefly a bird of the mid-Pacific, but it has been known to range to the eastward as far as the coast of Lower California.

Albatrosses are true ocean wanderers, returning once a year to some well-known island to rear their young. When they can trust these to care for themselves they put to sea, and the land knows them no

more until nature again sounds the nuptial call. Their prodigious power of flight enables them to keep on wing for hours at a time and to circle around the swiftest steamer on outstretched wings without apparent effort. The ocean is lonely at best, but it would be still lonelier except for the presence of these splendid voyagers that follow the track of every outward-bound ship and serve to shorten both to landsman and sailor the tedium of the long voyage.

The two species that nest on Laysan formerly densely colonized all available space. They are the chief source of the valuable deposit of guano on this island. The island guano deposits were leased by the Kingdom of Hawaii in 1890 and were profitably worked for several years, when the deposits became exhausted. So valuable is guano as the basis of a commercial fertilizer that the Peruvian Government is making careful investigations on several of its own islands as to the rate of deposit and the best means of mining and conserving the supply. Several other of the Hawaiian bird islands have been exploited for guano, and there is no doubt that if the safety and perpetuity of the bird colonies on these island reservations can be assured, the guano deposits can be worked at stated periods indefinitely and made the source of considerable profit.

Albatrosses on their nesting grounds are exceedingly tame and have so little fear of man as to permit close approach when on their eggs or when caring for their young. Their unsuspicious nature thus peculiarly exposes them to danger from feather hunters, as they can readily be killed with clubs. These big sea birds indulge in a curious pastime, which is in the nature of a grotesque dance or "cakewalk." (Pl. II.) Both the island species indulge in this practice, which has been witnessed and described by a number of observers. Prof. Homer R. Dill in his report thus records it as performed by the Laysan albatross:

The performance is varied, but usually begins as follows: One bird will approach another with an indescribable squeaking sound, bowing all the time. If the other bird feels like performing, which is usually the case, he bows in return. They cross bills very rapidly several times. Then one bird turns its head and lifts one wing in such a manner that the primaries point directly out at the side. In the meantime the other bird keeps up a loud noise that sounds somewhat like the neighing of a horse. The bird taking the lead then walks around his partner, stepping high, like a negro cakewalker. This part of the procedure is usually closed by one or both birds pointing their beaks straight up in the air, rising on their toes, puffing out their breasts, and uttering a long-drawn groan. The same thing is repeated many times with slight variations.

Just why the birds indulge in these curious antics it is difficult to conjecture, unless it is by way of amusement to pass away the time while on shore leave. Albatrosses are not at all exclusive, but are ever ready to acknowledge polite attentions from any and all sources, and when favored by a human being with a bow respond in kind with the utmost gravity and good will.

RAVAGES OF PLUME HUNTERS.

Eight years ago Mr. Bryan found much of Laysan literally covered with these splendid birds, but when visiting the island last year he discovered that more than half of the colony had been wiped out of existence by plume hunters. Prof. Dill estimates that only about one-sixth of the original colony of the species known as the Laysan albatross (*Diomedea immutabilis*) is left. The plume hunters landed on the island in May, 1909, and straightway began the work of slaughter. By the fall of the same year they had killed upward of 300,000 birds. While apparently albatrosses were the chief objects of pursuit, the feather hunters did not neglect other birds, and the list of slain includes, besides the Laysan and black-footed albatrosses, the sooty tern, gray-backed tern, noddy tern, Hawaiian tern, white tern, Bonin Island petrel, wedge-tailed shearwater, Christmas Island shearwater, red-tailed tropic bird, blue-faced booby, red-footed booby, man-o'-war bird, bristle-thighed curlew, and, without doubt, the island duck and such of the smaller birds as the hunters were able to secure. Bryan in his report to the department says, substantially:

The slaughter wrought by the foreign plume hunters is everywhere apparent. One of the work buildings formerly used by the guano company and later as a storehouse by the poachers is still standing. Though with a side torn out and left open to the weather by the men of the *Thetis*, it is still filled with thousands of pairs of albatross wings. Though weather-beaten and useless, they show how they were cut from the birds, whose half-bleached skeletons lay in thousands of heaps scattered all over the island.

Plume hunters the world over are not noted for the virtues of forbearance and humanity, but these men seem to have adopted exceptionally cruel methods on Laysan. Thus Prof. Dill in his report states:

An old cistern back of one of the buildings tells a story of cruelty that surpasses anything done by these heartless, sanguinary pirates, not excepting the practice of cutting the wings from living birds, leaving them to die of hemorrhage. In this dry cistern the living birds were kept by the hundreds to slowly starve to death. In this way the fatty tissue lying next to the skin was used up, leaving the skin quite free from grease, so that when they were prepared little or no cleaning was necessary.

Many other revolting sights, such as the remains of young birds that had been left to starve and birds with broken legs and deformed beaks, were to be seen. Killing clubs, nets, and other implements used by these marauders were lying all about. Hundreds of boxes to be used in shipping the bird skins were packed in an old building. It was very evident that they intended to carry on their slaughter as long as the birds lasted.

In January, 1910, the nefarious work was stopped by the arrival of the United States revenue cutter *Thetis*, and 23 poachers were arrested and conveyed to Honolulu, together with the plumage which they had baled preparatory to shipping to Japan. The wings and

plumage of approximately 259,000 birds were thus confiscated. As previously a party intent on the same errand had landed on Lysianski, another island of the same group, and spent months in killing sea birds and stripping off the plumage, it is probable that not far from a million of our sea birds were killed by aliens to sell to European milliners. The magnitude of the offense is better appreciated when it is understood that many sea birds, like albatrosses and others, lay only a single egg during the entire year, and as the natural mortality among both old and young is very considerable, years must elapse ere the greatly depleted colonies can be restored to their full strength. Dame Fashion has many sins to answer for, but few of greater magnitude than the wholesale slaughter of these stately creatures.

Had the raiders not been discovered, without doubt they would eventually have killed every nesting bird on this and the other accessible islands and converted these unique possessions of ours into veritable shambles. At the time of the visit of the party in the summer of 1911 heaps of the bodies of the slain still lay on the ground, mute witnesses of the sad fate that had overtaken these beautiful birds.

PROTECTION ESSENTIAL TO PRESERVATION OF RESERVATION AND SPECIES.

As the islands are part of our National possessions and have been set apart as a bird reserve, the care and the protection of their avian inhabitants would seem clearly to devolve upon the Federal Government. It is true that their remoteness and inaccessibility render it difficult to guard them properly. An effort, however, will be made to secure from Congress sufficient funds to provide for the services of a warden for Laysan and for an assistant. It is hoped also to secure a small power boat of adequate size to enable trips to be made between Laysan and the other islands and Honolulu. These measures, if supplemented by an occasional visit from one of the Government cutters during the height of the breeding season, will insure the continued safety of the nesting colonies. From a variety of causes sea birds are being reduced in numbers almost everywhere, chiefly as the result of plumage hunting and of the growing scarcity of breeding sites. Hence these island bird colonies, one of the wonders of the world, will become of increasing importance with each succeeding year. They should be regarded as a National heritage, and the birds be adequately protected, not only for the sake of our own citizens, but for those of other countries whose people go down to the sea in ships. Otherwise these birds will suffer the fate that overtook those on Marcus Island, also one of our possessions, where, as reported by Bryan, in six years a colony of albatrosses almost as large as that of Laysan was reduced to less than a score of birds through the unchecked activities of feather hunters.

Issued May 21, 1912.

U. S. DEPARTMENT OF AGRICULTURE
BIOLOGICAL SURVEY—BULLETIN No. 42
HENRY W. HENSHAW, *Chief*

REPORT
OF AN
EXPEDITION TO LAYSAN ISLAND
IN 1911

UNDER THE JOINT AUSPICES OF THE UNITED STATES
DEPARTMENT OF AGRICULTURE AND
THE UNIVERSITY OF IOWA

BY

HOMER R. DILL

Assistant Professor of Zoology in the State University of Iowa

AND

WM. ALANSON BRYAN

Professor of Zoology in the College of Hawaii



WASHINGTON
GOVERNMENT PRINTING OFFICE
1912

THE NEW YORK PUBLIC LIBRARY

ASTOR LENOX TILDEN FOUNDATION
1891



LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., January 11, 1912.

SIR: I have the honor to transmit herewith for publication Bulletin 42 of the Biological Survey, "A Report of an Expedition to Laysan Island in 1911," in two parts, the first by Prof. Homer R. Dill, of the State University of Iowa, and the second by Prof. Wm. Alanson Bryan, of the College of Hawaii, Honolulu. Prof. Bryan had previously visited the island in 1903 and was thus able to note the changes which had occurred during the intervening eight years. The Hawaiian Islands Reservation was established by Executive order in 1909 to serve as a refuge and breeding place for the millions of sea birds and waders that from time immemorial have resorted there yearly to raise their young or to rest while migrating. In 1909 a party of feather hunters landed on Laysan, one of the twelve islands comprising the reservation, and killed more than 200,000 birds, notably albatrosses, for millinery purposes. Through the prompt cooperation of the Secretary of the Treasury, the revenue cutter *Thetis*, under the command of Capt. W. V. E. Jacobs, was dispatched to the island and returned to Honolulu in January, 1910, with 23 poachers and their booty, consisting of the plumage of more than a quarter of a million birds. In the spring of 1911 a cooperative arrangement was effected with the University of Iowa, represented by Prof. C. C. Nutting, head of the zoological department, whereby an expedition was sent to Laysan, the largest and most important island of the group, to ascertain the present condition of the bird rookeries and to collect a series of birds for a museum exhibit. Through the cooperation of the Secretary of the Treasury and the Commandant of the Revenue Cutter Service the revenue cutter *Thetis* was placed at the disposal of the party. The members were transported from Honolulu to the island in April, and two months later returned to Honolulu. Through the courtesy of the Secretary of War transportation was also furnished on Army transports for members of the party and their equipage between San Francisco

and Honolulu. Without this assistance it would have been extremely difficult to arrange for the transportation of the expedition.

The present report embodying the results of the observations made by the party contains many interesting facts and gives an approximate census of the birds nesting on Laysan Island at the time of the visit of the party, together with recommendations for the future protection of the reservation.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS

PART I.		Page.
Introduction.....		7
Purpose and members of the expedition.....		7
Hawaiian Islands Reservation.....		8
Water and natural food supply.....		9
Seals.....		9
Rabbits introduced on Laysan.....		9
Guinea pigs.....		10
Insect pests.....		10
Birds as seed carriers.....		11
Narrative.....		11
List of birds on Laysan.....		13
Island bird census.....		23
PART II.		
Introduction.....		25
Comparison of conditions in 1903 and 1911.....		26
Recommendations for future protection of the reservation.....		29

ILLUSTRATIONS.

PLATES.

	Page.
PLATE I. Buildings on Laysan Island.....	12
II. Albatross wings piled in old guano shed.....	12
III. Nesting colony of Hawaiian terns.....	16
IV. Fig. 1.—White terns or love birds. Fig. 2.—Colony of wedge-tailed shearwaters	16
V. Laysan albatross rookery.....	16
VI. Fig. 1.—Christmas Island shearwater on nest. Fig. 2.—Red-tailed tropic bird with young.....	16
VII. Fig. 1.—Blue-faced booby. Fig. 2.—Red-footed booby.....	20
VIII. Man-o'-war birds on nests.....	20
IX. Fig. 1.—Laysan teal. Fig. 2.—Bristle-thighed curlew. Fig. 3.—Laysan rail	20

TEXT FIGURE.

FIG. 1. Map of Laysan Island.....	14
-----------------------------------	----

REPORT OF AN EXPEDITION TO LAYSAN ISLAND IN 1911 UNDER THE JOINT AUSPICES OF THE UNITED STATES DEPARTMENT OF AGRICULTURE AND THE UNIVERSITY OF IOWA.

PART I. - L -

REPORT ON CONDITIONS ON THE HAWAIIAN BIRD RESERVATION WITH LIST OF THE BIRDS FOUND ON LAYSAN.

By HOMER R. DILL,
Professor of Zoology in the State University of Iowa.

INTRODUCTION.

PURPOSE AND MEMBERS OF THE EXPEDITION.

On February 3, 1909, President Roosevelt issued an Executive order to the effect that the islets and reefs, namely: "Cure Island, Pearl and Hermes Reef, Lysianski or Pell Island, Laysan Island, Mary Reef, Dowsetts Reef, Gardiner Island, Two Brothers Reef, French Frigate Shoal, Necker Island, Frost Shoal, and Bird Island, situated in the Pacific Ocean at and near the extreme western extension of the Hawaiian Archipelago, * * * are hereby reserved and set apart * * * as a preserve and breeding ground for native birds. * * * This reservation to be known as the Hawaiian Islands Reservation."

The purpose of the reservation was to insure for all time a refuge and breeding place for the numerous species of birds, chiefly sea fowl, that for ages past had made the islands their home during the whole or a part of each year. In the spring of 1909, however, a party of foreign plumage hunters landed on Laysan, the principal bird rookery of the reservation, and for several months made the slaughter of sea birds a business. Had they not been interrupted, they would probably have exterminated the entire colony of birds on this island and perhaps on others of the group. As it was, many thousands of sea birds were destroyed, especially albatrosses. There is, however, no reason to doubt that, if left to themselves as much as possible and if further depredations can be prevented, the birds will in time repair this loss and continue to live as they have for thousands of years before civilized man intruded on their beautiful avian world.

Through the instrumentality of Prof. C. C. Nutting, head of the department of zoology, State University of Iowa, arrangements were made in 1911 with the Secretary of Agriculture to send a cooperative expedition to Laysan. The principal objects of the expedition were to obtain for the Bureau of Biological Survey of the department data for a comprehensive report as to the present condition of the rookeries and as to the effects of the nefarious work of poachers on the avifauna and to make a collection of the birds, their nests, eggs, and the necessary accessories for making a large panoramic group for the State University of Iowa.

The personnel of the party consisted of the writer and three assistants, Mr. H. C. Young, Mr. C. J. Albrecht, and Mr. C. A. Corwin. Mr. W. A. Bryan joined the party in Honolulu as the representative of the Department of Agriculture, spent a week on Laysan, and returned to Honolulu on the *Thetis*.

The writer is indebted to Mr. E. M. Ehrhorn, Mr. D. B. Kuhns, Mr. Max Schlemmer, Mr. W. A. Bryan, the members of the University Club, and others for their kind assistance and hospitality while in Honolulu. I wish also to acknowledge the invaluable assistance of the men who accompanied me: Mr. H. C. Young, who assisted in assembling data for this report, Mr. C. J. Albrecht, who made the photographs, and Mr. C. A. Corwin, who made paintings for our group. I am also indebted to Mr. Dayton Stoner, of our museum staff, for his careful drawing of the map on which I have indicated the bird rookeries.

HAWAIIAN ISLANDS RESERVATION.

The Hawaiian Islands Reservation is composed of the islands and reefs included in the leeward chain extending in a northwesterly direction from the main Hawaiian Group. These islands are situated from 100 to 300 miles apart and are composed principally of lava. Laysan, the largest island of the reservation, is low and flat, the highest point being only 50 feet above sea level. On the surface of this island is a layer of coral sand and phosphate rock. Laysan has an area of about 2 square miles; the others vary in size from 1 square mile to small rocky reefs. Bird Island is high and precipitous, having a peak of 903 feet, and one side of the island is perpendicular.

These islands have a vegetation of low bushes and sand grasses. The climate is warm but not enervating, tempered as it is by the northeast trade winds. Severe thunder storms are almost unknown.

At the present time the islands are entirely uninhabited by man, and indeed landing can be effected only in favorable weather; but they offer excellent nesting sites and abundant food for the millions of sea birds which resort to this remote oceanic reservation.

WATER AND NATURAL FOOD SUPPLY.

Frequent but short showers supplied us with plenty of drinking water. I have recorded them as follows: April 24, April 27, May 2, May 3, May 14, and June 2. We carried a small still for use in case our water supply failed us, but did not have occasion to use it, although our supply was reduced at times. There is an old well on the island, but it is no longer of use. The pump is rusted out and the well has partly filled with sand.

Plenty of good fish can be found in the still water between the surrounding barrier reef and the shore, and they can easily be shot with a good rifle. Crawfish also are obtainable and are easily caught in the evening by using a small lantern and a spear.

Large turtles are found along the beaches, where they crawl out to sun themselves. When turned on their backs they are helpless. We killed one of these turtles and found the meat very good, but the eggs we did not find palatable. This turtle was 4 feet long, 3 feet wide, and 1 foot 5 inches from carapace to plastron. We estimated her weight to be 300 pounds.

The rabbits are good for food and their flesh seems to be entirely free from parasites. When not frightened they may be easily caught in the hands.

Although there were many edible shore birds on the island, our party did not kill any of them for food. The only birds eaten were those collected for scientific purposes.

SEALS.

A little-known species of seal¹ is reported to live in the region of Laysan Island. Mr. Max Schlemmer says that during the 15 years he lived on the island seven of these animals were killed. He at one time gave Dr. Schauinsland a fine large skull of this species, which was taken to Germany. No signs of seals were noted while we were on the island, notwithstanding a sharp lookout was kept by the members of our party.

RABBITS INTRODUCED ON LAYSAN.

Mr. Max Schlemmer, the former manager of the guano company on Laysan, introduced domestic rabbits, Belgian hares, and English hares into the island at different times, and left them there to breed, intending to start a rabbit canning business. He could not give the

¹ This species has been described by Dr. Matschie as *Monachus schauinslandi* (Sitz. Ber. Ges. Naturf. Freunde, Berlin, p. 254, 1905). In 1900 a sick or helpless seal was caught by the natives in Hilo Bay, Hawaii, towed ashore, killed, and eaten. Unfortunately I was too late to secure any part of the animal for identification, but the natives assured me that solitary seals occurred on the coast about once in 10 years or so. They were very curious and asked many questions as to the habitat of the animal, its nature, food, and habits, about which they knew nothing.—H. W. HENSHAW.

exact dates but thinks the first were imported eight or nine years ago, or about 1903. The rabbits have crossed and produced some strange-looking animals, both in form and color. We dressed some of them for food and found the skins as tough and thick as that of the groundhog.

Rabbits have killed many bushes, but have not caused so great devastation as one would expect from their numbers. In the latter part of the afternoon they may be seen feeding. They are very fond of the green juncus that grows near the lagoon, and, while they are eating, their bodies are concealed among the thick growth and only their ears show. At times there are so many ears protruding that they resemble a vegetable garden.

It would be very difficult to exterminate these animals without harming the birds. They live everywhere; even in the large tern rookeries we saw many of them. They have made burrows of their own and also, when pursued, take refuge in the numerous petrel burrows. It is impossible to drive or snare them, as there are plenty of holes in which they can find shelter. Poisoning the rabbits would be disastrous to certain species of birds and indiscriminate shooting would also be harmful. It is my opinion that a well-organized party with small repeating rifles, say 22 caliber, could entirely exterminate these pests. This should be done in the season when it would interfere least with the nesting birds.

The man-o'-war birds catch them. Several times we saw them pick up full-grown rabbits, and we found young ones dead on the nest of the red-footed booby.

GUINEA PIGS.

Guinea pigs were found on the south end of the island in the thick juncus. They were rather abundant in this one place, seven being seen at one time, but they have done no harm. Mr. Schlemmer introduced these animals.

INSECT PESTS.

The collector is not without his troubles on Laysan. Never have I seen so many flies in one small area. Our laboratory was so full of them that we were obliged to suspend work to reduce their numbers. Shallow pans of formalin, about 2 per cent, did wonders in this direction. Not only did the flies annoy us as we worked but they would blow our bird skins, and even after the latter were thoroughly dry and cured, we often found fresh masses of eggs deposited on the feathers. The feet of the larger birds would be eaten by larvæ if they were not thoroughly poisoned.

In addition to the flies there were small ants which ate and destroyed the feathers of the smaller specimens. There were also several

species of beetles, the larvæ of which devoured everything that was not well poisoned.

Plenty of netting is needed to keep flies away from the skins while drying. Rough frames should be made and their legs immersed in pans of water, in order that boxes of skins may be placed in safety from the ants. The beetles are, however, harder to control, for they seem to reach the skins notwithstanding the netting. If the skins show signs of larvæ, put them in a tight box with a good cover. In the top of the box place a shallow pan of carbon bisulphide, using about one tablespoonful of the fluid for every cubic foot of space. Cover the box tightly, allowing it to remain 48 hours. The carbon bisulphide should be put in the top of the box, since the gas settles. This should be repeated in about seven days, so as to kill the larvæ that may have hatched in the meantime. Where pests are so prevalent, I recommend treating each box of skins in this manner as they are packed for shipment.

The acres of carcasses left by the poachers have furnished breeding places for flies and beetles; hence their great numbers.

BIRDS AS SEED CARRIERS.

Mr. H. W. Henshaw, Chief of the Biological Survey, requested that our party make careful observation as to the presence of seeds or balls of earth attached to any portion of the bills, feet, or plumage of the island birds, since there is reason to believe that birds play an important part in the transplantation of seeds from shore to shore.

In handling and preparing 400 specimens we found but one that was of interest in this connection. On the foot of a Laysan albatross, between the second and third toes, was a spinate seed about the size of a flattened buckshot, the spines of which were firmly embedded in the sides of the toes. The seed was sent to Washington, where it was identified as the seed of *Tribulus hystrix* R. Br. This species belongs to the family *Zygophyllaceæ* and is generally distributed in the South Sea Islands. So far as known there is no record of its occurrence on Laysan, but a thorough examination of the flora might reveal its presence there.

NARRATIVE.

The 17th day of April, 1911, our party sailed from Honolulu on the revenue cutter *Thetis*. During the first five days of our trip few birds were seen except a number of black-footed albatrosses (*Diomedea nigripes*) that followed the ship nearly all the way. When within about 50 miles of Laysan, their numbers increased, and later they were joined by one or two of the white species (*D. immutabilis*), also by a few sooty terns (*Sterna fuliginosa*) and wedge-tailed shearwaters (*Puffinus cuneatus*).

About 11 o'clock of the seventh day the island was sighted. We expected to see clouds of birds about it, but in this we were disappointed. It was too early for terns to arrive in large numbers. We reached the shore about 3 o'clock and spent the remainder of the day in landing our outfit and repairing the old building for our use. (Pl. I.) By 6 o'clock everything was beached and the *Thetis* sailed to Midway Island, coming back a week later for our mail and to say farewell until the 5th of June, when she returned for our party.

Our first impression of Laysan was that the poachers had stripped the place of bird life. An area of over 300 acres on each side of the buildings was apparently abandoned. Only the shearwaters moaning in their burrows, the little wingless rail skulking from one grass tussock to another, and the saucy finch remained. It is an excellent example of what Prof. Nutting calls the survival of the inconspicuous.

Here on every side are bones bleaching in the sun, showing where the poachers have piled the bodies of the birds as they stripped them of wings and feathers. In the old open guano shed (Pl. II) were seen the remains of hundreds and possibly thousands of wings which were placed there but never cured for shipping, as the marauders were interrupted in their work.

An old cistern back of one of the buildings tells a story of cruelty that surpasses anything else done by these heartless, sanguinary pirates, not excepting the practice of cutting the wings from living birds and leaving them to die of hemorrhage. In this dry cistern the living birds were kept by hundreds to slowly starve to death. In this way the fatty tissue lying next to the skin was used up, and the skin was left quite free from grease, so that it required little or no cleaning during preparation.

Many other revolting sights, such as the remains of young birds that had been left to starve and birds with broken legs and deformed beaks, were to be seen. Killing clubs, nets, and other implements used by these marauders were lying all about. Hundreds of boxes to be used in shipping the bird skins were packed in an old building. It was very evident they intended to carry on their slaughter as long as the birds lasted.

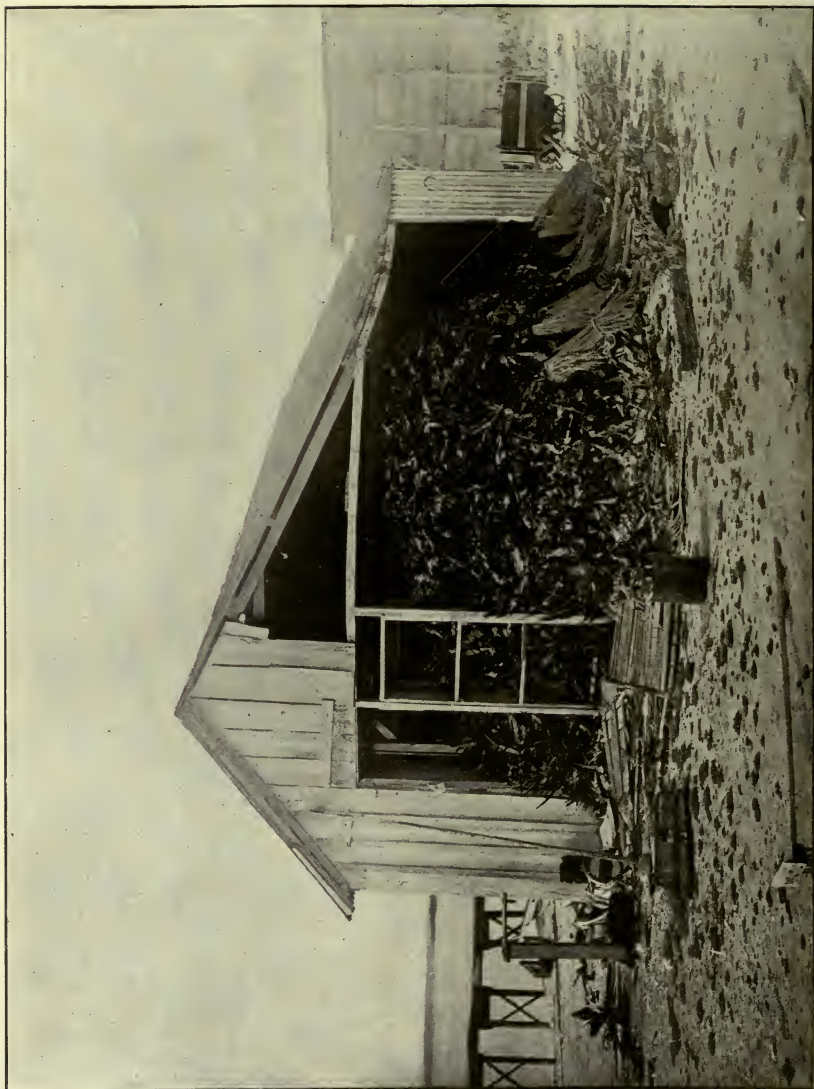
Not only did they kill and skin the larger species but they caught and caged the finch, honey eater, and miller bird. Cages and material for making them were found.

Half an hour's walk, however, will take one to an entirely different scene. The north, east, and south parts of the island have not been disturbed to any extent by the poachers, they having confined their work largely to the area nearer the buildings and along the car track formerly used by the guano company.

We found some species on the east side even more abundant than reported by Prof. Nutting in 1902. It is interesting to note the



BUILDINGS ON LAYSAN ISLAND.



ALBATROSS WINGS PILED IN OLD GUANO SHED, LAYSAN ISLAND.

habits of the gregarious little creatures. For countless generations they have lived in a crowded community, like the inhabitants of our larger cities, and now, although the killing of thousands of birds on the west side of the island has made nesting places available elsewhere, they still live as did their predecessors, nesting as closely as possible.

In collecting birds that had young, much care was exercised not to take both parents and thus to leave the nestlings to perish. This made the collecting of some species difficult and slow. Fortunately we were able to preserve and so utilize many birds that were found dead on the rookeries, the mortality from natural causes being large.

LIST OF BIRDS ON LAYSAN.

It is not my intention to attempt to duplicate the excellent report on the birds of Laysan Island by Dr. Walter K. Fisher¹ in 1902, to which readers are referred for many details here omitted. We found the same species that he did, with the addition of Bulwer's petrel and the sooty petrel (*Oceanodroma tristrami*). The following is a list of the island birds, with notes on their distribution, habits, nests and eggs, etc., as observed by our party:

LARIDÆ.

Sterna fuliginosa Gmelin. Sooty-backed Tern.

Upon our arrival at Laysan we did not observe many sooty-backed terns. There was a small colony of about 500 birds on the southwest part of the island and another of about the same size on the extreme east. We found great piles of bones near the former that led us to believe that the birds had been much reduced in numbers by the plumage hunters.

About the 6th of May thousands of them appeared on the east side of the island and about a week later others came to the southwest. Their numbers increased each day. As the southwest rookery grew, it extended toward the north. For some reason known only to themselves the birds confined their nesting to the area on the west side of the small car track, which is indicated on the accompanying map. We found a few nests between the rails, but none on the east side of the track. The first day of June we measured the rookeries of these birds, and two days later we went over the same ground again. We found that in two days the rookeries on the west side had increased in area 3,600 square yards.

The final estimate of the number of sooty terns was made June 4—333,900 for both rookeries. This species outnumbers any other on the island. We found as many as 7 and in some cases 9 nests to the

¹ Birds of Laysan and the Leeward Islands, Hawaiian Group, in U. S. Fish Commission Bulletin for 1903.

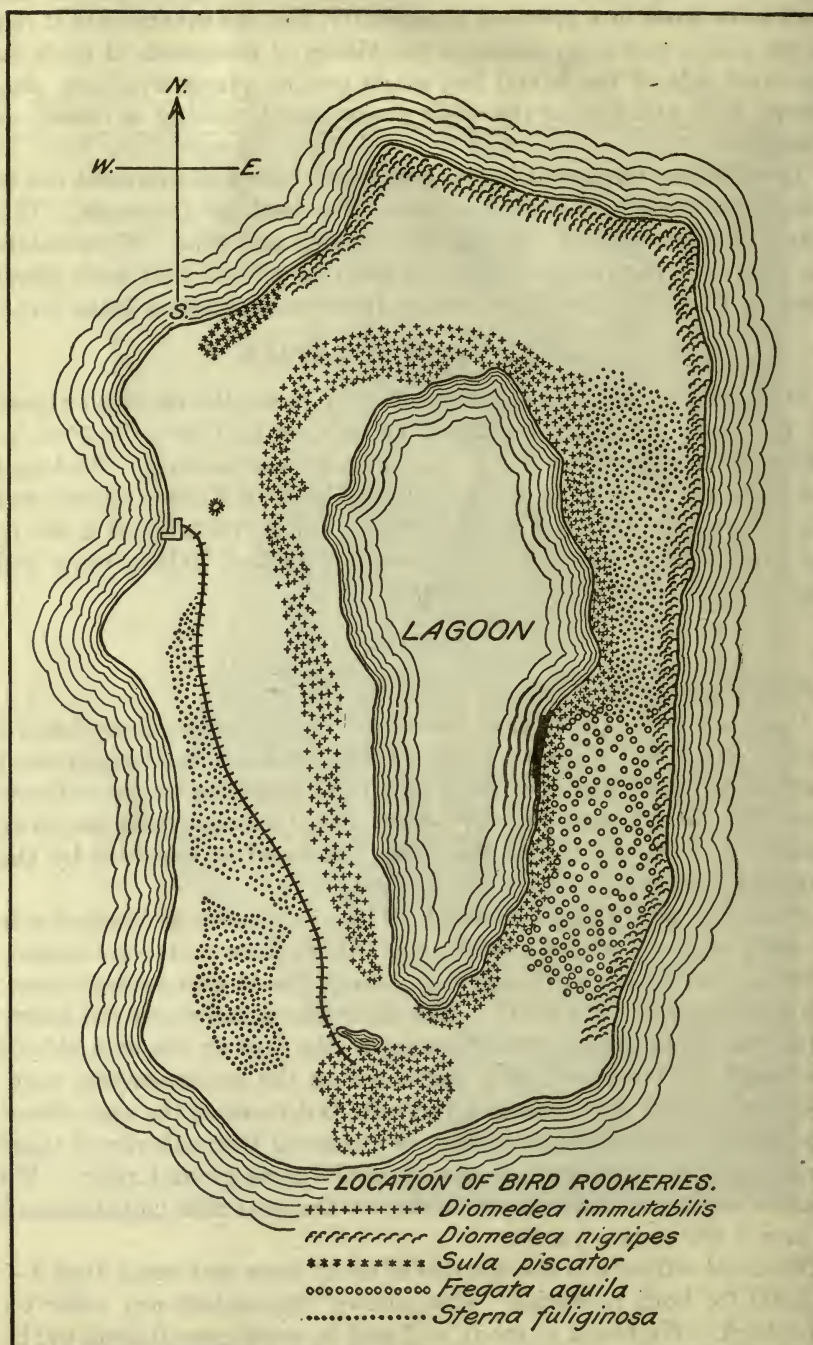


FIG. 1.—Map of Laysan Island.

square yard of ground. About 1 nest in 50 contained two eggs, one egg being the usual complement.

***Sterna lunata* Peale. Gray-backed Tern.**

On the rocks at the south end of the island is a small colony of gray-backed terns. Its close proximity to the sooty tern rookery might mislead the casual observer as to the number of birds of this species. As soon as the birds are disturbed the sooty terns fly about with the graybacks, giving the impression that there are thousands of the latter. The unfortunate grayback makes a desirable skin for millinery purposes; hence his demise.

There are other small rookeries on the east side, and we estimated that about 50,000 of these birds were nesting on the island. We found fresh eggs and young birds in all stages of development.

***Anous stolidus* (Linn.). Noddy.**

Noddies were nesting in small colonies on nearly all parts of the island. The northwest point seemed to be a favorite nesting place, and during the last week of May fresh eggs were found. The noddy is fairly abundant, numbering about 5,500.

***Micranous hawaiiensis* Rothschild. Hawaiian Tern. (Pl. III.)**

This little understudy of the noddy was found in all stages, from a freshly laid egg to a fully fledged bird. It was not so abundant as the noddy, numbering about 3,000.

***Gygis alba kittlitzii* Hartert. White Tern or Love Bird.**

During the first week of our stay in Laysan we saw but four white terns (Pl. IV, fig. 1). This little bird, never abundant on the island, was one of the first to disappear at the hands of the poachers.

About the time the sooty terns arrived in abundance we noticed a number of white terns. On the 15th of May we discovered several pairs nesting on the rocks at the south end and later found others on different parts of the island. At one time we were able to count 30 of these birds.

We collected six specimens, all of which, although nesting, were more or less pin-feathery and unfit for mounting. We estimated the number of this species to be 75.

DIOMEDIIDÆ.

***Diomedea immutabilis* Rothschild. Laysan Albatross. (Pl. V.)**

Along the shores of the lagoon and on a small area at the south end of the island this most remarkable and interesting bird has taken its last stand. To-day there is about one-sixth of the original colony left. All along the car track and on the main rookery where the birds were formerly so abundant, only piles of bones remain. The

poachers killed these helpless creatures with clubs and threw the wings and feathers into the cars, heaping the bodies up along the sides of the track as they worked, and used the cars to carry the spoils to the sheds.

About all of the old main rookery, where the birds were reported so plentiful by Prof. Nutting in 1902, has been annihilated; only now and then a pair of birds with young may be seen. Along the shores of the lagoon they are still to be found in large numbers, and to one who has never seen such masses of birds it is a wonderful sight.

Notwithstanding the treatment these birds have received, they still seem fearless of man, with the exception, perhaps, of a few stray individuals nearer the buildings which will not allow one to approach them.

They amuse themselves with a strange proceeding, which at times seems to be done more from a sense of duty than for pleasure. The performance is varied, but usually begins as follows: One bird approaches another with an indescribable squeaking sound, bowing all the time. If the other bird feels like performing, which is usually the case, he bows in return. They cross bills very rapidly several times. Then one bird turns its head and lifts one wing in such a manner that the primaries point directly out at the side. In the meantime the other bird keeps up a loud noise that sounds somewhat like the neighing of a horse. The bird taking the lead then walks around his partner, stepping high like a negro cakewalker. This part of the procedure is usually closed by one or both birds pointing their beaks straight up in the air, rising on their toes, puffing out their breasts, and uttering a long-drawn groan. The same thing is repeated many times with slight variations.

There were comparatively few young albatrosses. When the parent birds were feeding at sea, the rookery would seem almost deserted. We found a number of young birds dead, but the mortality from natural causes is not large, considering the number of this species. Something must have disturbed the birds earlier in the nesting season; possibly their eggs may have been taken.

An accompanying map (p. 14), on which I have indicated the larger rookeries, will show about the area occupied by this species. At the present time there are approximately 180,000 Laysan albatrosses.

For the benefit of those who have estimated the number of albatrosses as high as 10,000,000, I would like to call attention to the map made by the officers of the *Albatross* in 1902. According to this map Laysan has an area of about 5,420,800 square yards. Taking out the area of the lagoon, which is 471,500 square yards, we have 4,949,300 square yards. Place 10,000,000 birds the size of an albatross upon 4,949,300 square yards of ground; how much room would



NESTING COLONY OF HAWAIIAN TERNS, LAYSAN ISLAND.



FIG. 1.—WHITE TERNS OR LOVE BIRDS, LAYSAN ISLAND.



FIG. 2.—COLONY OF WEDGE-TAILED SHEARWATERS, LAYSAN ISLAND.



LAYSAN ALBATROSS ROOKERY.



FIG. 1.—CHRISTMAS ISLAND SHEARWATER ON NEST, LAYSAN ISLAND.



FIG. 2.—RED-TAILED TROPIC BIRD WITH YOUNG, LAYSAN ISLAND.

there remain for the rest of the bird population, to say nothing of the bushes and grass?

Diomedea nigripes Audubon. Black-footed Albatross.

Along the beaches of the north, east, and south sides of the island the black-footed albatross has taken almost complete possession. An occasional pair may be found nesting with the white species, but as a rule they are found by themselves.

The black-footed albatross is somewhat larger than the white species, and when seen on the wing it is instantly recognized as being far superior as an aviator. They followed our ship all the way from San Francisco to the Hawaiian Islands.

These birds have a performance similar to that of the former species, but much more elaborate, and they go through the figures slowly and gracefully. Instead of lifting one wing they raise both. The notes uttered during the performance are much softer, and it ends with a sound like the stroke of a bell under water or deep within the bird's stomach.

They are very neighborly with the other species. We often saw them visiting, and on one or two occasions they were trying to perform with them, but the rapid pace set by the white bird was rather too much for his more deliberate cousin and the affair ended disastrously.

The young of this species were rather abundant. During the first week of June many of them were fully fledged. The total number of black-footed albatrosses is about 85,000.

PROCELLARIDÆ.

Puffinus cuneatus Salvin. Wedge-tailed Shearwater.

The wedge-tailed shearwater (Pl. IV, fig. 2) is found on nearly every part of Laysan, with the exception of the beaches and the hard shores of the central lagoon. It does not fly about much during the day, but sits in the mouth of its burrow and dozes in the sun. At times a dozen or more of these birds congregate, apparently for the purpose of quarreling. Their cat-like squalls will soon make the listener wish to move out of hearing.

The young were nearly fledged. Apparently these birds were not killed to any extent by the poachers and they number about 100,000.

Puffinus nativitatis Streets. Christmas Island Shearwater.

The Christmas Island shearwater (Pl. VI, fig. 1) is a common bird on Laysan. We found it nesting under bushes and in shallow burrows. Its eggs were fresh during the first two weeks of May. Its retiring habits and unattractive plumage have protected it from the ravages of the poachers and it numbers about 75,000.

***Æstrelata hypoleuca* Salvin.** White-breasted Petrel, or Bonin Island Petrel.

Owing to its nocturnal habits the white-breasted petrel is not so conspicuous as some of the other species of its family, but it was abundant in the evening. It is a fearless, dove-like creature, quite amenable to petting and stroking.

The young of this species were nearly fledged. They were to be seen in the mouths of the deep burrows which completely honeycomb the higher ground of the island. This species bids fair to hold its own for some time to come, numbering 160,000.

***Bulweria bulweri* (J. & S.).** Bulwer's Petrel.

In Dr. W. K. Fisher's report of the Birds of Laysan Island, 1902, he states that he did not detect any Bulwer's petrels on Laysan. We were, therefore, somewhat surprised to find this species rather abundant, and at the same time of year that Dr. Fisher was there.

In the cracks and crannies of the rocks on the south end of the island one was sure of finding these birds, and in almost every case a pair of birds would be in the same opening. We found them also on other parts of the island, wherever there were pieces of phosphate rock or coral under which to crawl.

While we were after some specimens of coral rock, we were much surprised to find one of these quiet little birds sitting in the débris that had fallen from the under side as we applied the sledge hammer from above. The pieces had dropped in such a manner that, notwithstanding the falling of a piece weighing 75 pounds or more, the bird was unharmed and apparently not alarmed. Under the bird we found a fresh egg. This incident occurred on the 2d day of June, and although we had previously seen many of these birds, we had not found any eggs. Upon further investigation we found that the birds on the south end of the island had eggs, all of which were fresh. In some nests we found both birds sitting side by side. We estimated the number of this species to be 1,000.

***Oceanodroma tristrami* Salvin.** Sooty Petrel.

The sooty petrel is not a common bird on Laysan. Near the south end of the lagoon a number of young birds were found, all dead or in a dying condition. They were fully fledged, retaining only traces of down. A diligent search procured but two adult birds. These birds were so much smaller than the measurements given by Mr. Ridgway for this species that there was at first some question as to their identity.

The following table gives Mr. Ridgway's measurements, also those of the specimens referred to above:

O. tristrami.

MEASUREMENTS BY MR. RIDGWAY.

Sex.	Date.	Length.	Wing.	Tail.	Fork of tail.	Culmen.	Depth bill front of nostril.	Tarsus.	Mid. tcl.
-----	-----	Skin; about 11 inches.	7.50	4.45	1.60	0.70	0.25	1.10	1.10

SKINS COLLECTED ON LAYSAN BY OUR PARTY.

♀	Apr. 28	10.00	7.00	4.3	1.50	0.8	0.22	1.02	1.04
♂	May 22	9.8	6.54	4.1	1.20	.8	.20	1.04	1.06
	May 29	9.00	5.8	4.16	1.25	.76	.20	.94	1.16

PHAËTHONTIDÆ.

Phaëthon rubricaudus Boddaert. Red-tailed Tropic Bird.

During the first three weeks of our stay on the island we saw very few red-tailed tropic birds (Pl. VI, fig. 2). They were wild and very hard to catch. Later, however, we saw plenty of them, and as they were nesting, we experienced no trouble in catching them in our hands.

This species has by far the most beautiful plumage of any of the birds found here. Its rose-tinted satin body, with bright coral red beak, and its elongated central tail feathers make it a striking bird indeed.

The poachers have killed many of these birds, but they still seem fairly abundant, numbering about 300.

SULIDÆ.

Sula cyanops (Sundevall). Blue-faced Booby.

A small colony of blue-faced boobies (Pl. VII, fig. 1), was nesting on the sandy beach of the east coast. By actual count, 45 birds were there during the first week in May. Large downy young were in the nests, usually one but in some cases two. A few eggs were found, but all were well incubated.

On the 5th day of June we were somewhat surprised to find about twenty pairs of these birds nesting on the interior slope of the east side of the island in close proximity to the man-o'-war bird rookery. Why they should choose such an environment is hard to understand. Nearly all the nests contained two fresh eggs.

Not far from this spot we saw a man-o'-war bird pursuing a booby which had just returned from fishing, with a crop full of fish. At first it seemed as though the booby would outfly its pursuer, but its load was too heavy. The man-o'-war bird overtook the booby, seized it by the tail, raised itself in the air, and turned the booby completely over. Being thus rudely overturned the booby lost

control and quickly disgorged the contents of its crop, and the man-o'-war bird actually caught the fish as it came from the booby's mouth.

Sula piscator (Linn.). Red-footed Booby.

The red-footed booby (Pl. VII, fig. 2), like its relative, is not very abundant. They are confined to a small area on the north part of the island, nesting in the tops of low bushes. Their numbers increased about the same time we noted the increase of the former species. There were about 125 birds in all.

FREGATIDÆ.

Fregata aquila (Linn.). Man-o'-war Bird.

On the inner eastern slope of the island the man-o'-war birds (Pl. VIII) may be found. They nest in colonies in the tops of low bushes which, if placed near together, would cover about 6 acres. As it is, however, they appear to cover many times that amount of space.

Here sitting quietly on each nest is the owner thereof, holding down his claim. When one bird leaves the nest its mate immediately takes its place, for if a nest is left unguarded the birds that seem to be off duty swoop down, apparently passing nearly over it, when with a quick movement of the beak they pick up a stick and carry it away. Thus stick by stick the nest is completely removed. If there happens to be a young bird or an egg in the nest, it is destroyed and eaten by the winged cannibals.

One forgets the shortcomings of these birds when he sees them sailing on motionless wing far above him. It would seem that they make use of the hot air currents arising from the island and thus sail about with very little effort.

It seems strange that man-o'-war birds should have increased in numbers, when we think of their wholesale slaughter of each other's offspring, but according to previous reports they were less abundant on Laysan formerly than to-day, numbering 12,500 at the present time.

ANATIDÆ.

Anas laysanensis Rothschild. Laysan Teal.

No signs of the Laysan teal (Pl. IX, fig. 1) were seen for the first few days of our stay, and then we found feathers and other parts of those which the marauders had dressed for food. Later, however, we saw them in small flocks, six being the most seen at one time. Some teals seemed to be nesting in the grass near the small fresh-water pond on the south end of the island, but we were unable to find any nests.

The man-o'-war birds persistently pursued them, but they did not to my knowledge kill or harm any of them. They may, however, kill young teals.



FIG. 1.—BLUE-FACED BOOBY, LAYSAN ISLAND.



FIG. 2.—RED-FOOTED BOOBY, LAYSAN ISLAND.



MAN-O'-WAR BIRDS ON NESTS, LAYSAN ISLAND.



FIG. 1.—LAYSAN TEAL.



FIG. 2.—BRISTLE-THIGHED CURLEW, LAYSAN ISLAND.



FIG. 3.—LAYSAN RAIL.

Presumably the plumage hunters killed these birds for food, and thus nearly exterminated them. It would seem that without further molestation they might increase in numbers.

RALLIDÆ.

Porzanula palmeri Frowhawk. Laysan Rail.

The Laysan rail (Pl. IX, fig. 3) is one of the most interesting birds found on the island. Notwithstanding its inability to fly it has no trouble in evading its pursuers. It runs and dodges from one grass tussock to another, down a petrel hole and out again before one can locate it. One of the most laughable things imaginable is a man pursuing one of these bits of bird life, net in hand, continually dropping waist-deep down among the burrowing petrels. It was with much difficulty that we secured the specimens we needed for our collection. They were everywhere fairly abundant on all parts of the island excepting the beaches. They even visited our kitchen. Their favorite nesting place is among the thick mats of juncus along the margin of the lagoon. We found many nests but no eggs. On the 4th day of June we discovered two coal-black chicks with yellow beaks that gave vent to much noise. There are about 2,000 rails on the island.

SCOLOPACIDÆ.

Heteractitis incanus (Gmelin). Wandering Tattler.

Very few of these birds were seen on Laysan during our stay. Now and then one or two would be seen on the reef or among the large rocks on the beach, but they were very wild. One specimen only was secured.

Numenius tahitiensis (Gmelin). Bristle-thighed Curlew.

Just before sunset and early in the morning the bristle-thighed curlews (Pl. IX, fig. 2) would come up around our camp uttering their peculiar complaining notes. They roosted on the roofs of the old buildings at night, sometimes as many as 20 birds in one flock. We saw them feeding on different parts of the island but usually about the lagoon or along the beaches. They number about 250.

CHARADRIIDÆ.

Charadrius dominicus fulvus (Gmelin). Pacific Golden Plover.

The golden plover is only a migrant on Laysan. About 2,000 were present at the time of our visit.

APHRIZIDÆ.

Arenaria interpres (Linn.). Turnstone.

In the shallow water of the lagoon and about the fresh water pond, large flocks of plover and turnstones were to be seen. Here they spent most of their time feeding on the small flies with which the shore and water are black.

The specimens we prepared for our collection were exceedingly fat. We experienced some difficulty in securing good ones, as the birds were too wild to catch in a hand net and were easily ruined with a shotgun. The turnstones number about 2,500.

DREPANIDIDÆ.

Himatione fraithii Rothschild. Laysan Honey Eater.

The honey eater is not common on Laysan. There were four birds of this species that roosted on an old rope which hung across the corner in one of the sheds. Here each night we would see them huddled closely together. An occasional bird would flit into our workroom in quest of millers. They were to be seen about the island in the tall tussocks of grass, where we found a few nests, all of which contained young birds or well-incubated eggs. Among the old specimens left by the feather hunters we found several skins of the honey eater. There are possibly 300 living birds of this species.

Telespiza cantans Wilson. Laysan Finch.

One of the last birds to disappear from the island will be the Laysan finch. With its omnivorous habits and its saucy, fearless manner it easily adapts itself to conditions as it finds them. It is a fine songster and makes a good cage bird. Laysan Island is an ideal place for this bird, but should anyone be rash enough to introduce it to a civilized community it would be a pest that would rival the English sparrow.

They were everywhere abundant about the island, particularly near the tern rookeries. When we passed through the rookeries they would follow, to steal the eggs left exposed by the terns we had frightened away. They also eat other birds' eggs, not excepting their own species.

Our cook experienced much difficulty in keeping them from the kitchen. Each day brought more birds. At last he was obliged to put up a net at the door to keep them out. They also visited our storeroom, where they picked holes in our rice bag, making way with quite a quantity. At meal time they were about our feet picking at the crumbs on the floor. It was not an uncommon thing to see them on the table. They were nesting during the month of May, and we found many nests with fresh eggs. We estimated the total number of finches to be about 2,700.

SYLVIIDÆ.

Acrocephalus familiaris (Rothschild). Miller Bird.

With the exception of the Laysan teal, the miller bird is the least abundant of the indigenous birds. We saw a few of them around the old buildings and others about the island, but principally along the

west shore of the lagoon, in the tall grass, where a few nests containing eggs and young birds were found.

A pair made a nest not far from our sleeping quarters. The birds seemed not to mind our presence, working away at the nest when we were within 2 feet of it. After it was completed, the female bird died while laying an egg. We saved the skin of the bird, also the egg, which was removed intact. In a few days the male bird returned with a new mate, and, much to our surprise, the birds took down the nest, building a new one a few feet away.

It seems strange that this bird should not be more common, as it was formerly reported to be most abundant of the land birds. Presumably the poachers caught the miller bird, but we have no proof of it, as no skins or other parts were found. Its numbers are kept in check by the finches—at least we saw the latter eating the eggs of this species. Undoubtedly, however, this has been their practice for many years, and, unless the finches are more abundant than formerly, it ought not to make any appreciable difference in the numbers of the miller bird.

ISLAND BIRD CENSUS.

An estimate of the number of each species of bird found on the island was made. The method of estimating the number in the several rookeries was as follows: After carefully measuring a rookery, a square yard was selected that seemed to contain a fair average of nests. Counting two birds to a nest we determined the number in a rookery. In some cases this method could not be used, as some species do not assemble in large numbers but nest in small colonies among the other species. The map (p. 14) accompanying this report is not a criterion as to the number of birds in the various rookeries, but simply shows the location and approximately the area covered by the species indicated thereon. To avoid confusion I have indicated thereon only the birds that have sharply defined rookeries, the others being more or less united.

The following table shows at a glance the estimated numbers of most of the island birds:

<i>Sterna fuliginosa</i>	333, 900	<i>Sula cyanops</i>	65
<i>Sterna lunata</i>	50, 000	<i>Sula piscator</i>	125
<i>Anous stolidus</i>	5, 500	<i>Fregata aquila</i>	12, 500
<i>Micranous hawaiiensis</i>	3, 000	<i>Anas laysanensis</i>	6
<i>Gygis alba kittlitzii</i>	75	<i>Porzanula palmeri</i>	2, 000
<i>Diomedea immutabilis</i>	180, 000	<i>Numenius takitiensis</i>	250
<i>Diomedea nigripes</i>	85, 000	<i>Charadrius dominicus fulvus</i> ...	2, 000
<i>Puffinus cuneatus</i>	100, 000	<i>Arenaria interpres</i>	2, 500
<i>Puffinus nativitatis</i>	75, 000	<i>Himatione frathii</i>	300
<i>Æstrelata hypoleuca</i>	160, 000	<i>Telespiza cantans</i>	2, 700
<i>Bulweria bulweri</i>	1, 000		
<i>Oceanodroma tristrami</i>	3		
<i>Phaethon rubricaudus</i>	300		
			1, 016, 224

PART II.

REPORT ON CONDITIONS ON LAYSAN, WITH RECOMMENDATIONS FOR PROTECTING THE HAWAIIAN ISLANDS RESERVATION.

By WM. ALANSON BRYAN. - M -

Professor of Zoology in the College of Hawaii.

INTRODUCTION.

On the occasion of my recent visit to Laysan Island during the week from April 24 to 30, 1911, which was made on board the U. S. revenue cutter *Thetis*, in company with a party from the State University of Iowa who were making the journey to the island to secure material and background studies for a large group to be assembled at that institution, I was able to study conditions as I found them in this wonderful bird colony and compare them with conditions existing there at the time of my former visit in April, 1903.

The slaughter of tens of thousands of birds by the party of feather and wing hunters and the depredations now being wrought by the rabbits and guinea pigs that have been introduced on the island make it important, if this colony is to be saved from extermination, that every effort to this end be made, both by the Federal Government and by the Territory of Hawaii. It will be necessary (1) to have the islands in the Leeward chain of the Hawaiian group properly patrolled and protected; (2) to take steps to exterminate or reduce the rabbits on Laysan Island; (3) to distribute the peculiar land birds on Laysan to other islands of the chain in order to prevent their early extermination; (4) to introduce the important economic species on the inhabited islands of the group; (5) to plant on Laysan and the other islands certain trees and shrubs that will flourish on them; (6) to develop this valuable possession of the Territory of Hawaii as the great natural parks are developed elsewhere—as a natural breeding preserve for wild birds. Since the birds are all perfectly fearless, the reservation may be visited at any season under proper regulations, thus affording to the Hawaiian Islands a unique opportunity to preserve this great colony in a flourishing condition and at the same time utilize the chain of otherwise unimportant and unproductive islands, over a thousand miles in length, as a cruising and camping park and fishing ground, the like of which is found nowhere else in the world.

Several months ago it became my duty as the representative of the National Association of Audubon Societies in Hawaii to notify that society and the Biological Survey that the island of Laysan of the Leeward chain of this group had been visited by a company of feather hunters. They were under the employ of Mr. Max Schlemmer, now of Honolulu, but who was for many years a resident on Laysan as manager for a large guano and fertilizer concern with headquarters in Honolulu.

After spending several months on the island engaged in the wholesale slaughter of the bird life there, the poachers were taken off by the U. S. revenue cutter *Thetis* under command of Capt. Jacobs, who was sent there by the Federal Government for that purpose. With the 23 poachers who were brought to Honolulu for trial the *Thetis* brought two or three carloads of the feathers, wings, and birdskins that had been made ready for shipment to Japan. Had the plan of the promoters been carried out, they would doubtless have been sent from Japan to the fashion centers of Europe and America for millinery purposes.

COMPARISON OF CONDITIONS IN 1903 AND 1911.

By my experience on Marcus Island and Midway Island a few years ago, where I had the sad privilege at the first-named island of finding a colony of poachers actually engaged in killing birds by the thousands for the millinery market, and at the latter of finding the hundreds of heaps of dead birds' bodies left by a party that had finished securing its ship load of wings and feathers, I was in a measure able to anticipate the damage that had been done by these ruthless spoilers at Laysan.

My surprise was great, however, to find that the few rabbits introduced by Mr. Schlemmer shortly after my former visit had literally taken possession of the island. In 1903 Mr. Schlemmer, then operating a lease and engaged in the guano business, made a number of trips from Honolulu. On a number of these voyages he took several small shipments of rabbits of different breeds as well as a number of Japanese guinea pigs. All of these animals were liberated on Laysan and they have since multiplied until they are found in great numbers at this time.

The slaughter wrought by the plume hunters is everywhere apparent. One of the work buildings formerly used by the guano company and later as a storehouse by the poachers is still standing. With a side torn out and left open to the weather by the men of the *Thetis*, it is still filled with thousands of pairs of albatross wings. Though weatherbeaten and useless, they show how they were cut from the birds whose half-bleached skeletons lie in thousands of heaps scattered all over the island.

This wholesale killing has had an appalling effect on the colony. No one can estimate the thousands, perhaps hundreds of thousands, of birds that have been willfully sacrificed on Laysan to the whim of fashion and the lust for gain. It is conservative to say that fully one-half the number of birds of both species of albatross that were so abundant everywhere in 1903 have been killed. The colonies that remain are in a sadly decimated condition. Often a colony of a dozen or more birds will not have a single young. Over a large part of the island, in some sections a hundred acres in a place, that 10 years ago was thickly inhabited by albatrosses, not a single bird remains, while heaps of the slain lie as mute testimony of the awful slaughter of these beautiful, harmless, and without doubt beneficial inhabitants of the high seas.

While the main activity of the plume hunters was directed against the albatrosses, they were by no means averse to killing anything in the bird line that came in their way. As a consequence large numbers of all the different species of birds that occur on the island were killed. Among the species slaughtered may be mentioned black-footed albatross, Laysan albatross, sooty tern, gray-backed tern, noddy tern, Hawaiian tern, white tern, Bonin Island petrel, wedge-tailed shearwater, Christmas Island shearwater, red-tailed tropic bird, blue-faced booby, red-footed booby, man-o'-war bird, bristle-thighed curlew, and without doubt many of the few species of the smaller birds peculiar to Laysan as well as those that visit it as migrants.

Fortunately, serious as were the depredations of the poachers, their operations were interrupted before any of the species had been completely exterminated. So far as the birds that secure their food from the sea are concerned, it is reasonable to suppose they will increase in number, and that nature will in time restore the island to its former populous condition if no further slaughter is permitted. Owing to the indiscriminate method of the killing, usually only one or the other of mated pairs was sacrificed. The unmated birds that survive are slow in selecting another mate. As but a single egg is laid by the majority of these birds, it will possibly take 10 years for the sea birds of the colony to regain their former numerical strength.

With the land birds an entirely different condition exists. All the small species peculiar to the island, except possibly the Laysan teal, depend entirely upon the vegetation on the island for their food supply. The uninterrupted and astonishing increase in the numbers of rabbits and guinea pigs can have but one result if allowed to continue unchecked. They will surely eat or kill off all of the grass and shrubs. Doubtless the insects that feed on the plants and in turn are fed upon by the birds will be so reduced as to bring about starvation among the small birds.

The struggle for existence on Laysan is most keen at all times. The inevitable operation of the law of nature that balances the food supply with the number to be fed is as effective on this sand island as it is everywhere else in the world. As a matter of fact, a marked reduction in the number of pairs of all the land birds can be noticed as compared with the number of the same species on the island eight years ago. The Laysan canary, Miller bird, Laysan honey eater, and the Laysan rail, without doubt, are doomed to extermination on the isolated island on which they have maintained themselves long enough to develop into distinct species, unless something is done to preserve for them the source of their food supply.

Rare as the Laysan teal has always been, it is gratifying to find that it has not been wiped out of existence. Eight years ago there were several small flocks of this interesting bird, which is without doubt the rarest wild duck in the world. This year only seven adult birds were seen during an entire day especially devoted to watching for it on the small fresh-water lake and the main lagoon—the natural rallying place for the species. Ducks were seen on five of the seven days spent on shore, but there were by no means as many of them as there were on the occasion of my former visit. One pair seen had a flock of five young following them. Thus it will be seen that while this rare species is not extinct, as was greatly feared, it is so rare that there are probably not more than a half dozen adult pairs on the island at this time.

Even after the wholesale slaughter of the birds and the result it had on their nesting and mating habits, the birds remain as fearless as ever. There is not a species on Laysan that can not be caught in the hands with a little care and patience. One pair of ducks, for example, came up within 6 feet of the writer, a lack of fear which would make the species an easy one to exterminate should poachers at any time make another raid on the island inhabitants.

Rabbits now literally swarm over the island by thousands. The amount of damage done by them can better be imagined than told. They are exterminating first one species of plant then another. Several species that were common everywhere eight years ago have entirely gone, others are already doomed. Unless some drastic measures are resorted to within a very short time not a bush or spear of grass will be alive.

There is no indication that the islands of Laysan and Laysanski have been visited by hunting vessels since the last visit of the *Thetis*. It is to be hoped that for the time being at least the traffic in birds' wings and feathers has been broken up in these waters. However, there is no assurance that it will not be renewed without notice, hence the necessity for continuing the service of the *Thetis* or a similar vessel, and the necessity of making frequent visits at irregular intervals to all of the islands of the reservation.

RECOMMENDATIONS FOR FUTURE PROTECTION OF THE RESERVATION.

As to the future care of this wonderful colony, I would suggest that the most effective way to conserve the bird life is to appoint a warden for the reservation who should have general supervision of these low-lying islands and their bird inhabitants. A resident warden should then be provided who should be supplied with a small auxiliary power schooner, or a large power sampan, that would enable him to make frequent and unannounced visits at irregular intervals to all of the islands along the chain. The installation of a wireless telegraph station at Midway, where the power and facilities are already available, would add greatly to the convenience and safety of commerce and trans-Pacific travel and would put the islands of the chain in direct touch with Honolulu and the outside world.

If a vessel such as has been suggested should be stationed at Laysan or Midway Island it would be an important step toward the proper supervision of all the outlying islands, whether included in the reservation or not. Naturally the people and the authorities of the Territory of Hawaii feel a keen interest in the welfare of this reservation. A feeling is growing that the day is not far distant when this Territory will look upon the Leeward chain of islands as forming a great natural park as interesting and wonderful in its way and as instructive to visit as are any of the other famous national parks.

The visiting of these islands and reefs by interested persons, should they be opened to the public under proper regulations and supervision, will result in no harm to the breeding colony, as the long residence of the guano company on the island of Laysan has proven. As years go by and the birds become more rare elsewhere, the great reservation thus conserved in the mid-Pacific will be an object of world interest and concern. The birds themselves are a valuable possession to Hawaii and the nation, while as an attraction to visitors as well as to the residents of these islands they represent, as yet, an asset that is scarcely appreciated.

It is urged that the Federal Government and the Territorial government should at once become actively interested in these islands and that measures should be taken to safeguard the birds against the possibility of further despoliation by plume hunters. It is also urged that steps should be taken to introduce the rare land birds of Laysan on other of the low islands of the chain where conditions are favorable in order to prevent the extermination of these interesting and valuable birds in the manner I have suggested.

At least three of the land forms of Laysan are of unquestioned economic importance and of great value to the Territory of Hawaii as the natural enemies of certain noxious and injurious insects. The difficult problem of their transportation and introduction into the

inhabited islands should be taken up vigorously and without delay by the Territorial government. One of the main objects of the writer's recent trip to Laysan was in the interest of the Territory and made for the purpose of studying the habits of these birds on the ground with the foregoing practical object in view. The visit just made and the experiments carried on while en route and on the island resulted in working out simple and practical methods of transportation which, it is believed, if followed up, will make it possible to capture and transport living specimens of these delicate insect-eating species for long journeys at sea without serious loss.

ADDITIONAL COPIES of this publication
may be procured from the SUPERINTEND-
ENT OF DOCUMENTS, Government Printing
Office, Washington, D. C., at 10 cents per copy



United States Department of Agriculture,

BUREAU OF BIOLOGICAL SURVEY—Circular No. 84.

HENRY W. HENSHAW, Chief of Bureau. — N —

DISTRIBUTION OF THE AMERICAN EGRETS.

By W. W. COOKE,

Assistant, Biological Survey.

The accompanying maps show the distribution of the two common white herons or "egrets," so called from the long plumes or "aigrettes" worn during the breeding season. The demand of the millinery trade for these plumes has caused such wholesale slaughter of these two species that they are almost extinct over large areas where they were formerly common. The maps indicate the original range of the species, before fashion decreased their numbers, and therefore the range which they may be expected again to occupy if sufficient protection from persecution is afforded.

Fortunately in the case of each of these species, breeding colonies still remain in the southern United States to serve as centers of distribution to the districts formerly included in the range.

Each spot on the maps represents a positive record—either the capture of a specimen which is now preserved in one of the larger public museums, notably the United States National Museum, at Washington, or a record, published or unpublished, now on file in the Biological Survey, of the observation of the birds by persons so familiar with the species as to leave no reasonable doubt of the correctness of the identification. It should be understood that these spots represent only a small proportion of the places at which the birds actually bred. They outline the regions in which the birds occurred and throughout which they were likely to be found in any favorable locality. It should also be understood that the birds are now more common than the records published during the last ten years would seem to indicate. Severe persecution has driven the few remaining wanderers to seek the remote uninhabited parts of the country, and it is only when a bird strays into a settled region that it is noted and recorded.

EGRET. (*Herodias egretta.*)

This egret is variously called American egret, white egret, white heron, and often the great white heron, to distinguish it from the

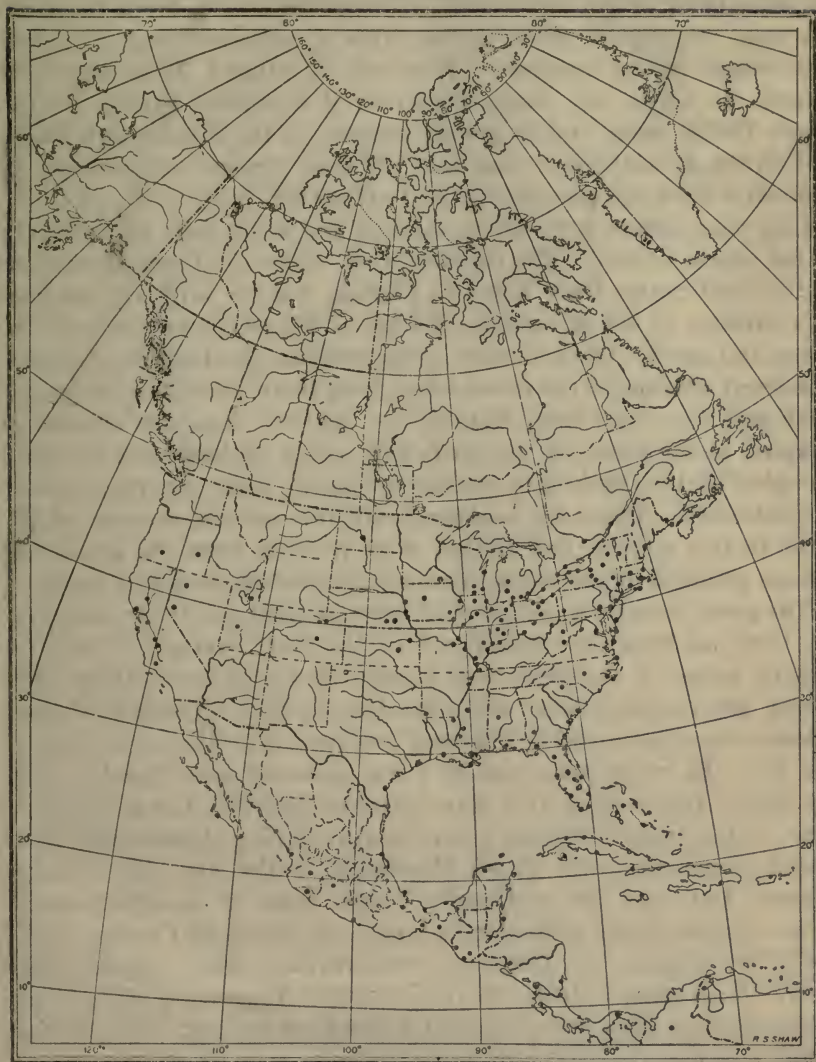
smaller, snowy egret. It breeds in colonies and the nests are usually placed high up in tall trees standing near or in water. The habit of breeding in colonies has greatly facilitated the work of destruction, since the market hunter has only to visit the rookery when the young are in the nests (the plumes of the parent birds are then at their finest) to kill off the entire colony. No matter how often the parents are shot at, they will continue to return with food for the young until the last one perishes. Incidentally the young are left to starve.

The egret is one of the most widely distributed of the whole family of herons. Originally it ranged from southern Canada to Patagonia, and throughout the whole of that extensive area the same story of persecution has been repeated. To-day there is no place in its North American range where it is common. The largest colonies in the United States were formerly along the Gulf coast from Louisiana to Florida, up the Atlantic coast to southern New Jersey, and up the larger rivers of the Mississippi Valley to Wisconsin and Indiana. So generally distributed were these herons in Indiana that they have been known to nest in Knox, Gibson, Daviess, Dekalb, Steuben, Noble, Jasper, Porter, Lake, and Starke Counties. The southern third of Indiana marked the northern limit of the great breeding colonies, where, in Daviess County, as many as a thousand birds have been seen in a single flock; but smaller colonies nested north to northern Indiana, and even two-thirds of the way up the western shore of Lake Michigan to Two Rivers, Wis.

The numbers formerly breeding near the Pacific coast were not as great as in the interior, owing to the lack of suitable nesting sites, but several strong colonies existed around Tulare Lake, Cal., and a large colony found congenial conditions near Malheur Lake, in eastern Oregon. So thoroughly has the plume hunter done his work that only a pitiable fraction is left in California.

Notwithstanding the severe persecution to which the birds have been subjected, a remnant of the species is still left, for during the last 10 years the birds have been recorded at the following places:

- Rhode Island*: East Greenwich, August 16, 1904; Point Judith, August 2, 1909.
New York: Montauk, July 23, 1900; Ontario County, August, 1905; East Windham, July 18, 1906.
New Jersey: Ridgewood, July, 1902; Wading River, August, 1905; Englewood, July 22, 1906; Black Point, July 6, 1908; Seabright, August 5, 1908.
Pennsylvania: Berwyn, July 26, 1902; Bristol, July 20, 1906; Ashbourne, July 30, 1906.
Ohio: Cincinnati, August, 1902.
Indiana: Waterloo, April 22, 1905.
Arkansas: Walker Lake, nested 1910.
Missouri: A few nested in southeastern part of State before 1900.
Nebraska: Nehawka, May 2, 1905.
Colorado: Near Denver, April 26, 1907.

Distribution of the Egret (*Icrodia egretta*).

SNOWY EGRET. (*Egretta candidissima*.)

This smaller white heron is even more beautiful than its larger relative, for during the breeding season, in addition to the long dorsal plumes, it is adorned with beautiful plumes on both head and neck. On account of its superb nuptial plumage the snowy heron has been the most sought of plume birds, with a correspondingly marked diminution in its numbers. Formerly it ranged from southern Canada to Chile and Argentina; now it is almost extinct on the whole Pacific coast, and so greatly reduced in the Mississippi Valley and on the Atlantic coast that only the most rigorous enforcement of protective laws can prevent its total extinction.

Like most herons it breeds in colonies and hence falls an easy prey to the plume hunter. The colonies were largest and most numerous in the Gulf States from Texas to Florida, but the bird was not rare as a breeder in the Mississippi Valley as far north as southern Indiana and on the Atlantic coast as far north as southern New Jersey. The great swamps of the lower Ohio, with their abundance of proper food and enormous trees suitable for nesting sites, are admirably adapted to the needs of the birds and would undoubtedly be again occupied by this strikingly handsome species under a proper system of protection. There are comparatively few natural enemies of the birds in this section, and if they were relieved from the attacks of human persecutors the annual increase in numbers would be rapid.

The great colonies were killed off between 1880 and 1888; since then the bird has been very rare north of the Gulf States. A very extensive series of rookeries was located formerly in southern New Jersey and the birds were still abundant in 1872. The last of these colonies were destroyed in 1886 and 1887, one man killing 73 birds in one day. In recent years one bird was observed near Camden, July 16, 1904. The nesting of a single pair at Sayville, Long Island, in 1885, is the latest breeding record north of New Jersey; the latest breeding records in the upper Mississippi Valley are 1890 in Knox County, Ind., and 1895 at Lincoln, Nebr. Some of the latest records in the northern part of the bird's range are: Saratoga County, N. Y., 1893; St. Albans, Vt., October, 1890; Billings, Mo., August, 1895; Odin, Ill., August 7, 1895; Cleveland, Ohio, August 25, 1889; Dunnville, Ontario, May 18, 1884; and Lake Koshkonong, Wis., August, 1886.

Distribution of the Snowy Egret (*Egretta candidissima*).

U.S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

609

Contribution from the Bureau of Biological Survey, Henry W. Henshaw, Chief.
September 11, 1914.

BIRD HOUSES AND HOW TO BUILD THEM.

By NED DEARBORN,
Assistant Biologist.

INTRODUCTION.

Birds may be gathered about us in all seasons of the year with ease and certainty merely by offering what they desire. In winter they are often pushed for food, and if we supply this need they will report daily at the lunch counter and help to relieve the tedium of our indoor life. In summer they care less for food provided by their human friends, and other means must be sought to attract them about the home. They appreciate fresh water for bathing and drinking. A shallow pool of varying depth, if only a foot across, becomes on hot days a center of attraction for all the birds in the vicinity, and it may be made with little effort and material; only a small amount of cement is required, or, if that be lacking, a pan with stones in it set in the ground will be equally serviceable. Trees, shrubs, and vines bearing fruit relished by birds are great attractions in their season.¹

Birds are desirable about premises not only on account of their beauty and song, but because of their economic worth. They are especially useful as insect destroyers during the breeding period, when they have to work early and late to obtain sufficient food for their nestlings, and their movements at this time are more interesting than during any other season. There is, therefore, a double purpose in offering them special nesting facilities. If mud is available, swallows, robins, and phœbes will found and wall their nests with it. If we put out feathers, bits of wool, or twine, a dozen different kinds of birds will make use of them. If we furnish safe retreats in which they can rear their young comfortably, most of them will be occupied. In fact no attraction for summer birds is more effectual

¹ See U. S. Dept. Agr. Yearbook 1909, pp. 185-196, "Plants Useful to Attract Birds and Protect Fruit," by W. L. McAtee (Yearbook Separate 504.)

NOTE.—This bulletin is intended to encourage the protection and study of birds; it is suitable for distribution in all sections of the United States.

than a series of houses suited to the needs and habits of the various kinds of house birds.

A few years ago only four species were commonly regarded as house birds—the house wren, the bluebird, the tree swallow, and the martin. Since the movement to protect birds and make neighbors of them began, however, their natures and needs have become better understood, and it is now known that many other species will avail themselves of houses constructed for them by their human friends. The practice of erecting bird houses in this country, while now nation-wide, is not so common and uniformly distributed as it should be, and more extended provisions of this nature can not fail to result in a largely increased number of house birds.

HOUSE BIRDS INCREASING IN NUMBER.

The habit of nesting in bird houses has been adopted by individuals of many species which would not ordinarily be expected to make use of such homes, and this may be taken as indicating that it will become more general from year to year as facilities are afforded and as the number of birds hatched in houses increases.

That western wrens and bluebirds should take as naturally to artificial shelters as did their eastern relatives was to be expected. On the other hand, the use of houses by birds which until recently had persistently ignored them is surprising and must be considered a victory for those who have studiously attempted to enlarge their circle of feathered neighbors.

Woodpeckers, nuthatches, and titmice excavate their own houses, usually new ones each year, leaving the old homes to less capable architects. Builders of artificial houses generally go to the woodpecker for designs, and by varying styles to suit the tastes of different kinds of birds, have been rewarded by such tenants as chickadees, tufted titmice, white-breasted nuthatches, Bewick and Carolina wrens, violet-green swallows, crested flycatchers, screech owls, sparrow hawks, and even some of the woodpeckers, the master builders themselves. Flickers readily accept houses built according to their standards. Red-headed and golden-fronted woodpeckers are willing occupants of artificial houses, and even the downy woodpecker, that sturdy little carpenter, has, in one instance at least,¹ deemed such a home a satisfactory abode in which to raise a family. Shelters having one or more sides open are used by birds which would never venture into dark houses suited to woodpeckers. They have been occupied by robins and brown thrashers, and, in one instance, by a song sparrow.²

¹ Reported by Jefferson Butler as occurring on the Ford farm, near Detroit, where great pains have been taken to provide for birds.

² This song sparrow record is another surprise from the Ford farm, announced by Mr. Butler, which is very encouraging to those experimenting with bird houses.

The number of house birds may be still further augmented as time goes on. All of the commoner woodpeckers are likely to be included, as are several of the small owls and wrens, and a few of the wild ducks, as the golden-eye. The wood duck is already known to use nesting boxes. Houses set close to streams in the western mountains will probably be occupied by ousels or dippers. Florida grackles sometimes breed in flicker holes and may be expected to occupy houses now and then. In every locality having trees there is a group of birds ready to appropriate houses when they have the opportunity.

SUGGESTIONS FOR CONSTRUCTING HOUSES.

House birds differ decidedly in their requirements. For those which usually excavate homes for themselves, the diameter of the entrance and the depth and diameter of the cavity must be in accord with their specific standards. Some birds are satisfied with almost any sort of a lodging. Bluebirds and wrens, for example, are content to build in tomato cans, although chickadees and nuthatches disclaim them. Wood is a better building material than metal or earthenware. Entrance holes should be countersunk from the outside to exclude rain. Heads of nails and screws should be set rather deeply and covered with putty. All houses should be easy to open for cleaning. A perch at the entrance is unnecessary and may even be an objection, as it is frequently used by English sparrows while they twitter exasperatingly to more desirable occupants. To provide for proper ventilation a row of small holes is sometimes bored just beneath the eaves, but there should never be a ventilating hole lower than the entrance, and joints should be made tight, as drafts of air are dangerous. In case there is danger that rain may be driven in through the door, a small drainage hole, which will be covered by the nest, may be made in the middle of the floor.

The appearance and durability of houses are improved by a coat of paint. A neutral shade of green or gray is suitable for houses mounted in trees, while those on poles, being conspicuously placed, lend themselves harmoniously to the landscape when painted white.

The dimensions of nesting boxes shown in Table 1 are taken from the experience of successful builders and from measurements of woodpecker holes.

TABLE 1.—*Dimensions of nesting boxes for various species of birds.*

Species.	Floor of cavity.	Depth of cavity.	Entrance above floor.	Diameter of entrance.	Height above ground.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Feet.</i>
Bluebird.....	5 by 5	8	6	1½	5 to 10
Robin.....	6 by 8	8	(1)	(1)	6 to 15
Chickadee.....	4 by 4	8 to 10	8	1½	6 to 15
Tufted titmouse.....	4 by 4	8 to 10	8	1½	6 to 15
White-breasted nuthatch.....	4 by 4	8 to 10	8	1½	12 to 20
House wren.....	4 by 4	6 to 8	1 to 6	1	6 to 10
Bewick wren.....	4 by 4	6 to 8	1 to 6	1	6 to 10
Carolina wren.....	4 by 4	6 to 8	1 to 6	1½	6 to 10
Dipper.....	6 by 6	6	1	3	1 to 3
Violet-green swallow.....	5 by 5	6	1 to 6	1½	10 to 15
Tree swallow.....	5 by 5	6	1 to 6	1½	10 to 15
Barn swallow.....	6 by 6	6	(1)	(1)	8 to 12
Martin.....	6 by 6	6	1	2½	15 to 20
Song sparrow.....	6 by 6	6	(2)	(2)	1 to 3
House finch.....	6 by 6	6	4	2	8 to 12
Phoebe.....	6 by 6	6	(1)	(1)	8 to 12
Crested flycatcher.....	6 by 6	8 to 10	8	2	8 to 20
Flicker.....	7 by 7	16 to 18	16	2½	6 to 20
Red-headed woodpecker.....	6 by 6	12 to 15	12	2	12 to 20
Golden-fronted woodpecker.....	6 by 6	12 to 15	12	2	12 to 20
Hairy woodpecker.....	6 by 6	12 to 15	12	1½	12 to 20
Downy woodpecker.....	4 by 4	8 to 10	8	1½	6 to 20
Screech owl.....	8 by 8	12 to 15	12	3	10 to 30
Sparrow hawk.....	8 by 8	12 to 15	12	3	10 to 30
Saw-whet owl.....	6 by 6	10 to 12	10	2½	12 to 20
Barn owl.....	10 by 18	15 to 18	4	6	12 to 18
Wood duck.....	10 by 18	10 to 15	3	6	4 to 20

1 One or more sides open.

2 All sides open.

HOUSE PLANS.

Possibilities in the way of improvising bird houses with very little work are suggested in figures 1 and 2. Ordinary tomato cans treated in either of the ways here indicated will be tenanted by wrens and bluebirds.



FIG. 1.—Tomato can with circular piece of board fitted in one end, to make house for bluebirds or wrens.



FIG. 2.—Tomato can, with one end removed, fastened to top of post. Hole cut in side for entrance. Suitable for bluebirds or wrens if put in shady place.

The cans ought always to be placed in shaded

places, as the metal becomes very hot in the sun.

Bird houses in the Southern States have long been made from gourds. The entrance is in the side and a drain hole in the bottom, as shown in figure 3. A piece of wire through the neck for mounting it completes the house. A number of gourds thus prepared and strung on a pole seems to make a satisfactory tenement house for a colony of martins. Used singly they are equally well adapted to wrens and bluebirds. While gourds are not durable when exposed to the weather they are easily replaced.



FIG. 3.—Gourd for martins.

Ordinary wooden boxes, if clean, can be made into bird houses by merely nailing on a cover and cutting out an entrance hole. Such makeshifts are rarely weatherproof and are never pleasing to the eye.

Branches containing real woodpecker holes, when obtainable, are perhaps the best attraction that can be offered most house birds in the breeding season. By carefully fitting such a branch to a fruit or shade



FIG. 4.—Gourds arranged for martins.

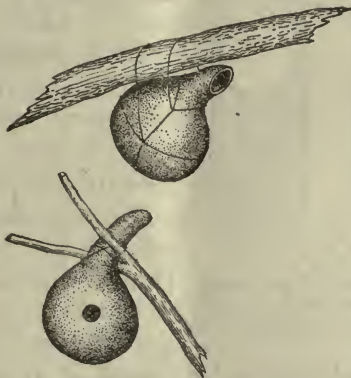


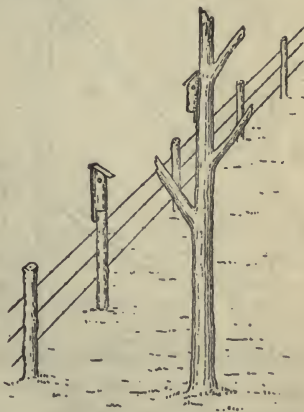
FIG. 5.—Gourds for wrens or bluebirds.



FIG. 6.—House made from hollow log.

tree its foreign origin will scarcely be noticed. The house shown in figure 6 is suitable for use in trees. It is made from a log or large branch, hollowed by decay, and fitted with a top and bottom as illustrated in the figure. The cover is to go on after the log is fastened in place. Either

the top or bottom should be removable. Methods of doing this are shown in figures 23 and 26. Another way of making a log house is to split a straight-grained log 2 feet or more in length through the middle and then to cut out a cavity with a gouge. The excavations in the two halves can be made to match exactly by means of a pattern or template having the size and shape desired for the proposed cavity through the plane of cleavage. Figure 7 shows the appearance of such a house and how to place the template symmetrically on each half of the stick. The top of this house should be covered with tin or zinc to keep out moisture. The halves should be fastened together with screws to allow the house to be taken apart and cleaned.



Phoebes like to nest about buildings, and a simple shelf under the roof of a porch or shed is all they require. If, however, it is desirable

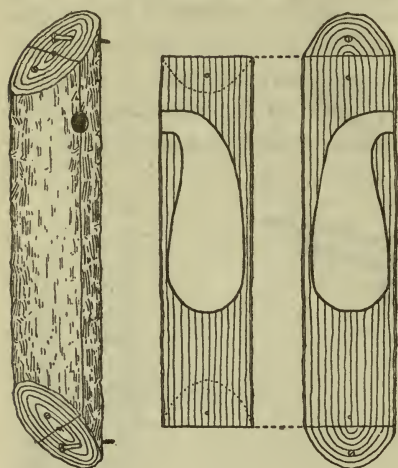


FIG. 7.—Log split and halves marked to be gouged out to form a cavity. Halves to be screwed together. Top should be covered with tin or zinc.

to have them stay outside, the shelf must be provided with a roof. Figure 8 shows a shelf shielded from the weather by one wall and a roof. This shelf if placed high under the eaves of a two-story building may attract barn swallows; phoebes and robins also are likely to build upon it if it is not less than 8 feet from the ground. In some cases it will be advisable to leave only one side open.



A nest shelter designed to be placed in shrubbery for catbirds, brown thrashers and song sparrows is shown in figure 10. As it

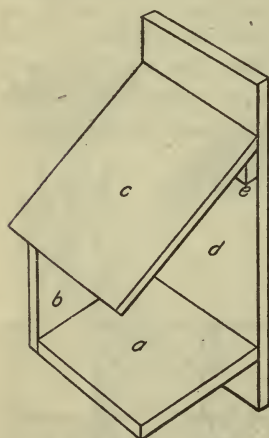
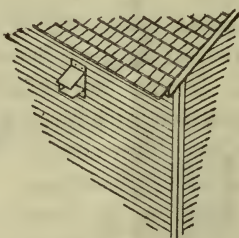


FIG. 8.—Outdoor nest shelf.



requires little lumber or labor, one may well be placed in every patch of weeds or brush frequented by these birds. Fastened to a large horizontal branch or in a crotch of a tree it is likely to be used by robins.

The house shown in figures 12 to 15 is designed to be set on a pole or a tree stub for the use of swallows especially. It can be cleaned by simply lifting the box from

its base. Bluebirds and wrens, as well as swallows, nest in this style of house though they prefer a deeper cavity. Another pole house is shown in figure 17. This is essentially after the woodpecker model and is suitable for bluebirds. By releasing the hooks which fasten the box to the base, cleaning is easy. Figure 19 illustrates a house to be attached to a tree. It can be

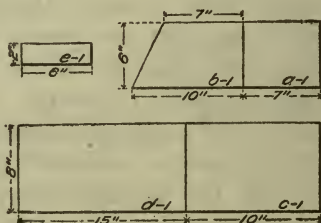


FIG. 9.—Diagrams for outdoor nest shelf shown in figure 8.

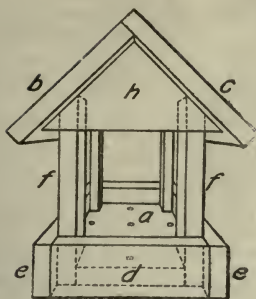


FIG. 10.—Nest shelter.

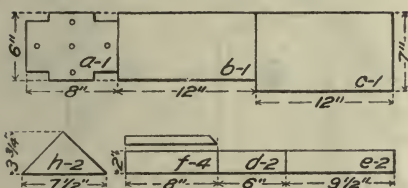


FIG. 11.—Lumber diagrams for nest shelter shown in figure 10. Thickness of boards $\frac{3}{4}$ inch.

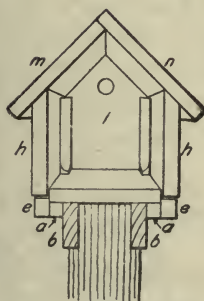


FIG. 12.—Cross section and interior view of front half of house for swallows and bluebirds.

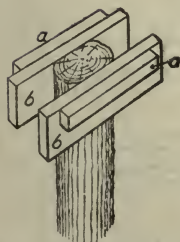


FIG. 13.—Foundation for house shown in figure 12.

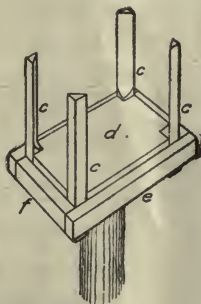


FIG. 14.—Floor and posts added to foundation shown in figure 13.

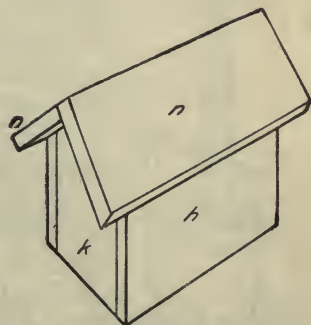


FIG. 15.—House ready to place over floor and posts as shown in figure 14.

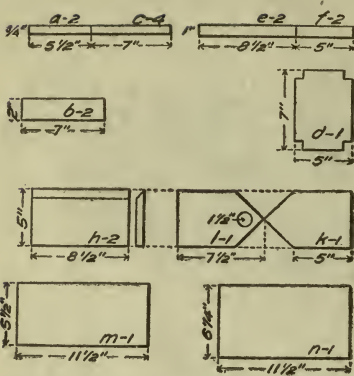


FIG. 16.—Lumber diagrams for building house shown in figures 12 to 15. Thickness of boards $\frac{3}{4}$ inch.

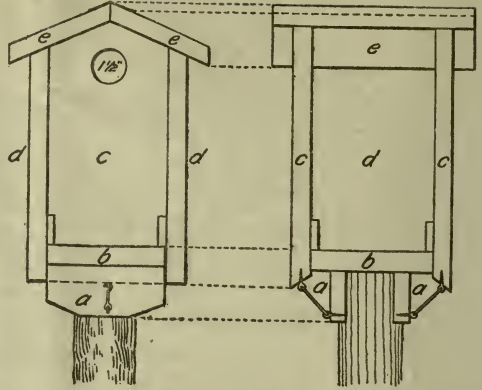


FIG. 17.—Diagrammatic drawings of bluebird house. This house can be removed from its floor by unfastening two wire hooks.

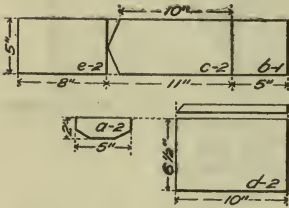


FIG. 18.—Lumber diagrams of house shown in figure 17. Thickness of boards $\frac{3}{4}$ inch.

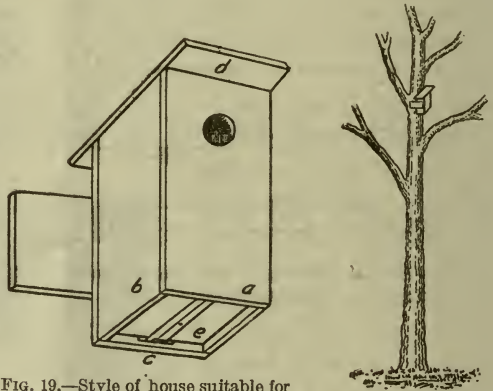


FIG. 19.—Style of house suitable for sparrow hawks, screech owls, bluebirds, and wrens. Designed to be placed in trees. Bottom can be removed by turning button.

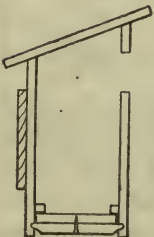


FIG. 20.—Section of house shown in figure 19.

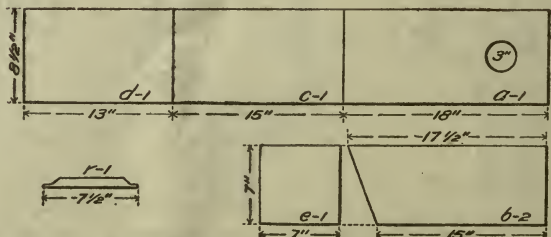


FIG. 21.—Diagrams of house shown in figure 19 for sparrow hawks and screech owls. Thickness of boards $\frac{3}{4}$ inch.

opened for cleaning by turning a button and removing the bottom. This house is easy to build and if suitably proportioned is adapted to a great variety of birds. Plans are furnished for two sizes—one for bluebirds and the other for screech owls or sparrow hawks.

The flicker house shown in figure 23 is designed to be placed on a post or the stub of a tree. The roof can be lifted in the same way that a stopper is removed from a bottle. A house suitable for members of the woodpecker family and also for nuthatches and titmice, including chickadees, is shown in figure 25. It is attached to boles of trees. The bottom is removable, as appears in figure 26.

Figure 29 shows a house designed for wrens and house finches. For wrens it may be placed on a tree or fence post. If attached near the eaves of a building, house finches or wrens will use it. The front gable is open, entrance to the room below being through the rear of the upper floor. This house can be opened for cleaning by lifting out the upper floor.

Martin houses are built on the apartment plan to satisfy the social instinct so marked in martins but so conspicuously lacking in most other birds. They usually contain not less than 10 or 12 rooms and for this reason are relatively complicated, especially if they are miniatures of elaborate buildings, as is often the case. Like the single room houses, they should be easy to inspect and clean from top to bottom and, if possible, should be made proof against the English sparrow. An attempt

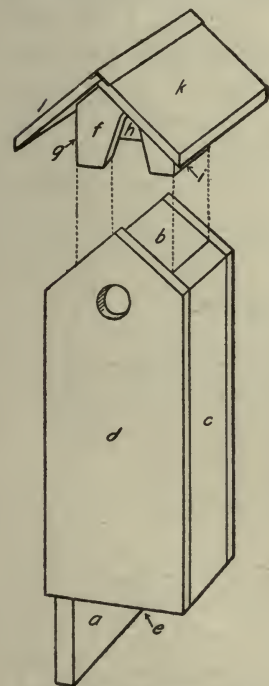


FIG. 23.—Flicker house to be mounted on post or stub of tree.

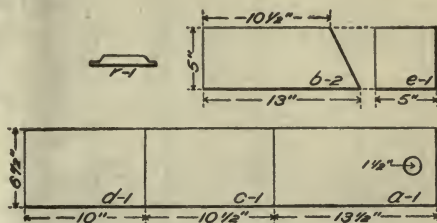


FIG. 22.—Diagrams of house shown in figure 19 for bluebirds. Thickness of boards $\frac{1}{2}$ inch.



to combine these essentials in a plain house is illustrated in figure 32. The body of this house slides upon its pole, to the top of which the roof is solidly attached (fig. 36). The pole is hollow and

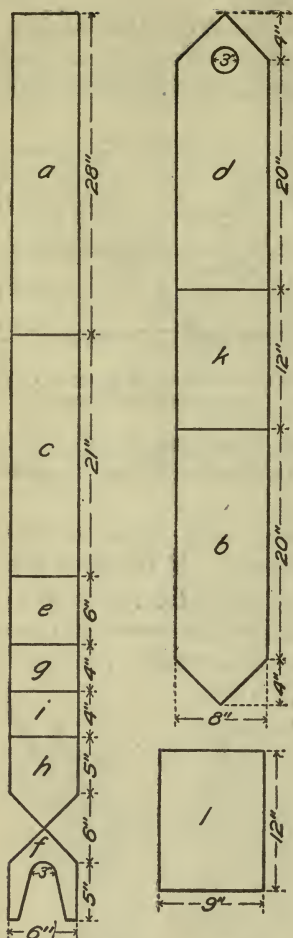


FIG. 24.—Lumber diagrams for flicker house shown in figure 23. Thickness of boards $\frac{3}{4}$ inch.

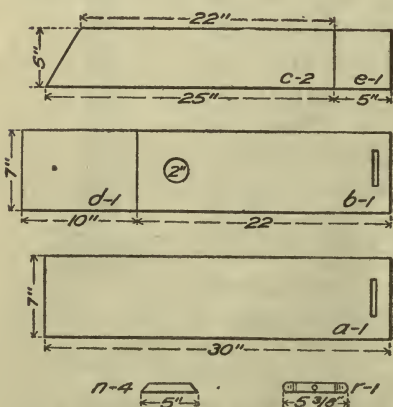


FIG. 28.—Lumber diagrams of house shown in figure 25, suitable for red-headed woodpecker. Thickness of boards $\frac{3}{4}$ inch.

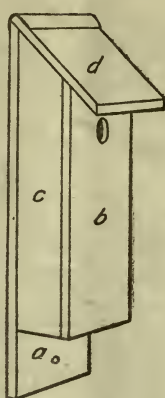


FIG. 25.—House to be placed in tree for woodpeckers, chickadees, nuthatches, or titmice.

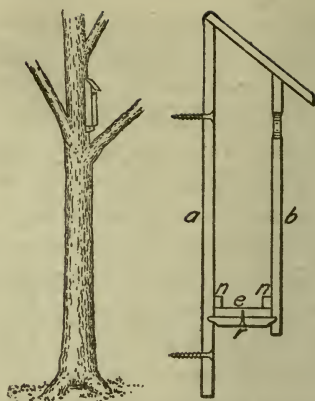


FIG. 26.—Section of house shown in figure 25.

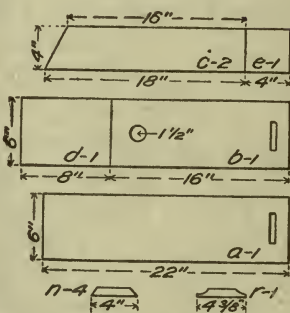


FIG. 27.—Lumber diagrams of house shown in figure 25, suitable for downy woodpecker. By reducing size of entrance it becomes right for titmice and nuthatches. Thickness of boards $\frac{3}{4}$ inch.

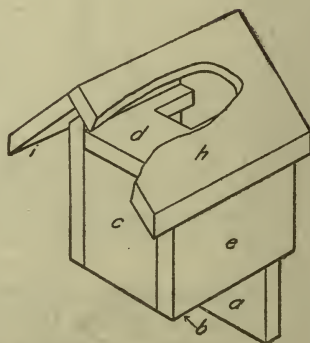


FIG. 29.—House for wrens and house finches. Roof broken to show interior.

through it runs a cord by which the house is raised and lowered. The floors are all removable by lifting up. When the house is out of contact with the roof all of the entrances are closed by gates actuated by springs, the gates moving upward to close, and being kept down and open by pressure against the roof. By means of this device sparrows may be kept out of the house until martins are due to arrive, or if they get in when the house is open they can be trapped by suddenly lowering it. The pole shown here is made from hardwood boards put together with screws. The concrete base has a core of 2-inch iron pipe which extends upward far enough to make a firm connection with the upper part on which the house slides. A

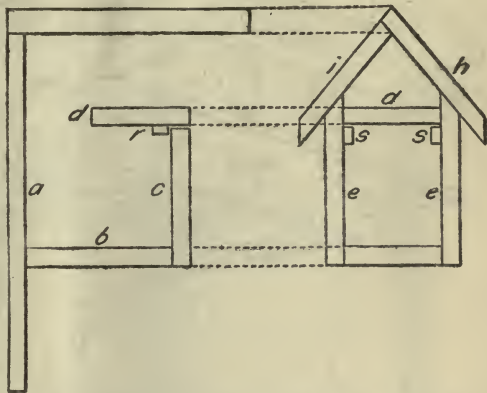


FIG. 30.—Sections of house shown in figure 29. Upper floor removable.

heavy weight is employed to hold the house hard against the roof. By passing the cord around the hook of the weight exactly as shown in figure 39 and pulling it upward until the weight is clear of the ground, it can easily be held without slipping while a more secure knot can be tied. A hook less wearing to the cord and fully as serviceable may be made from an acute natural crotch of oak or other

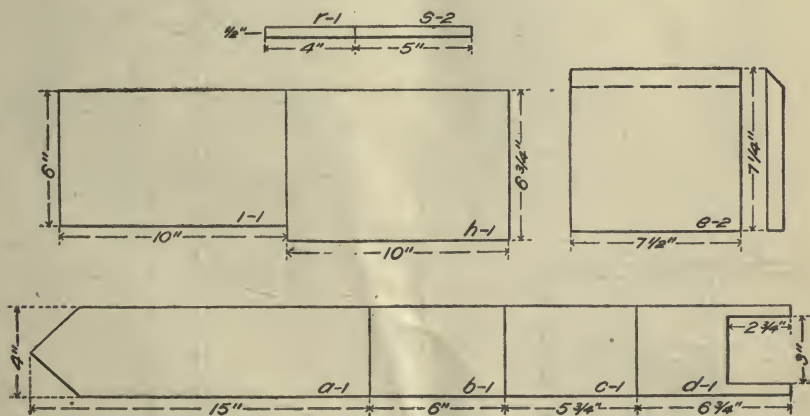


FIG. 31.—Lumber diagrams for house shown in figure 29. Thickness of boards $\frac{1}{2}$ inch.

hardwood instead of iron. Where this house is exposed to strong winds it may be advisable to attach guy wires to corners of the roof. The pole may be made of a single piece of 4-inch galvanized pipe, set in a concrete base. In this case the house should be a cylinder and the roof a cone.

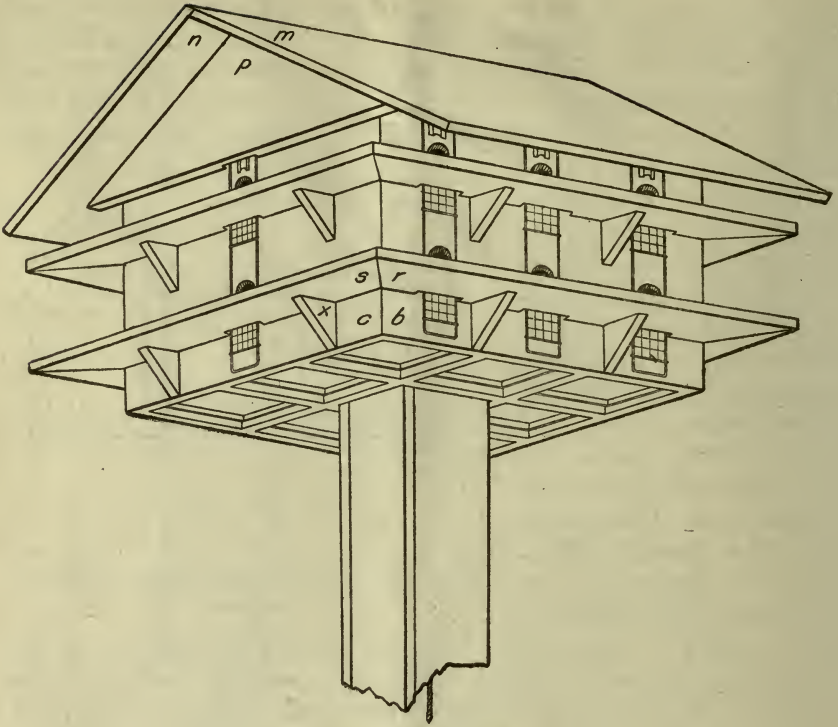


FIG. 32.—Martin house.

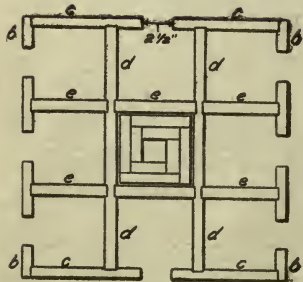


FIG. 33.—Horizontal section of martin house.

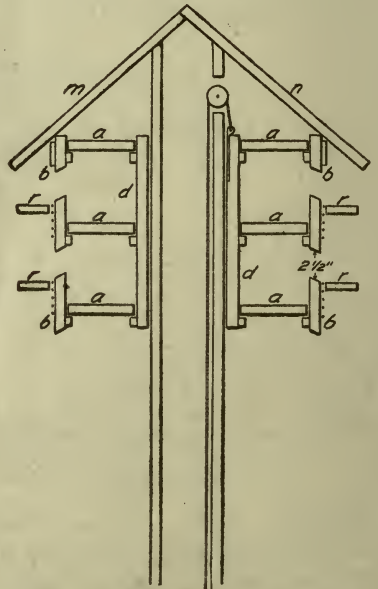


FIG. 34.—Cross vertical section of martin house; raised, and doors open.

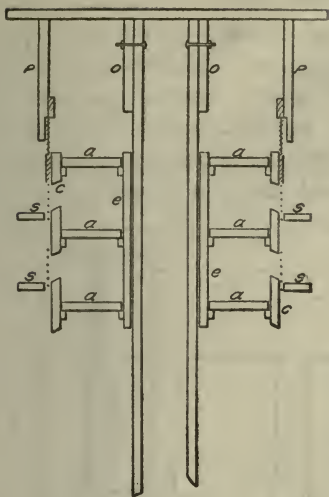


FIG. 35.—Longitudinal vertical section of martin house; lowered, and doors closed.

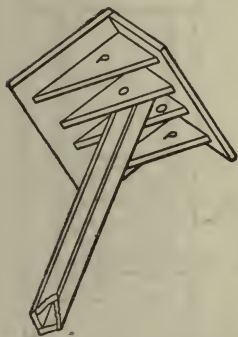


FIG. 36.—Roof of martin house attached solidly to pole.

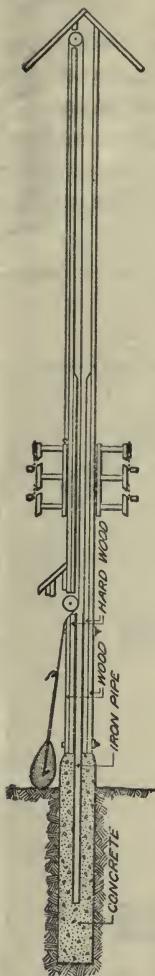


FIG. 37.—Martin house lowered; doors closed.

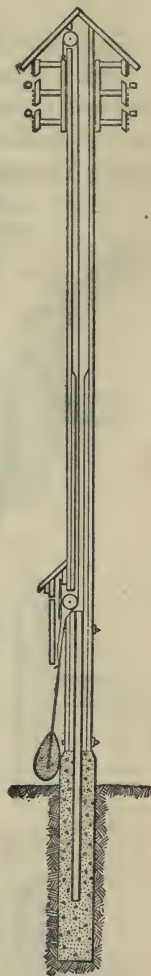


FIG. 38.—Martin house in place; doors open.



FIG. 39.—Proper way to make first "hitch" of rope on hook of counterweight.

CARE OF HOUSES.

Each spring before birds return from the South all filth and litter should be carefully removed from bird houses. In addition to the relics of previous occupancy, houses are likely to contain cocoons of insects, and nests of bees or squirrels. Attention to this one item of spring cleaning is a substantial factor in attaching birds permanently to their houses. A little sulphur scattered about a house is a good

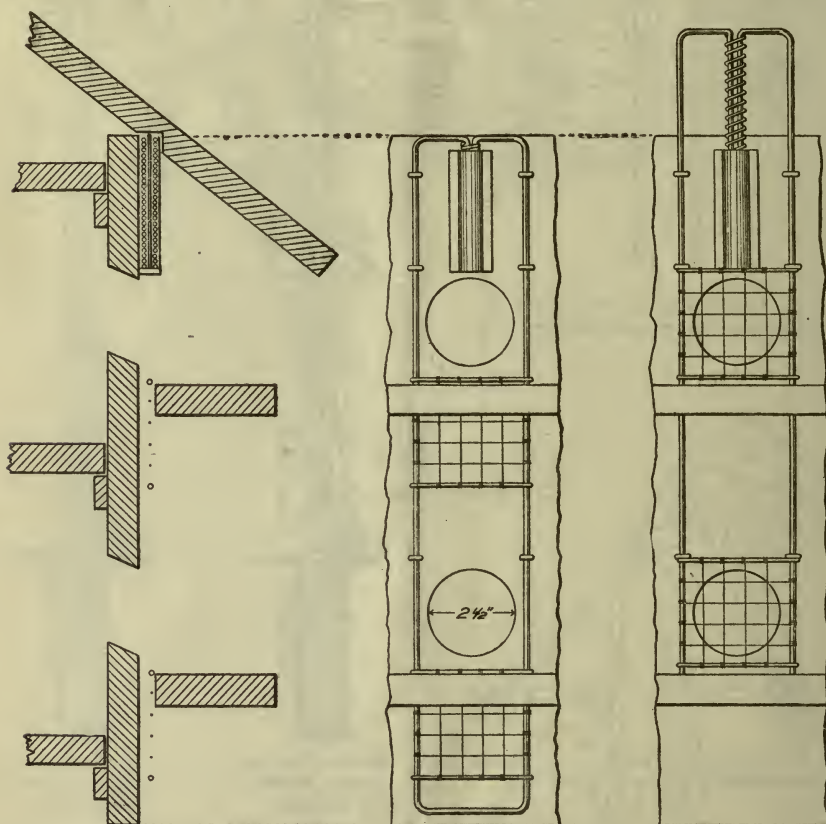


FIG. 40.—Details of construction and operation of gates.

remedy for parasites. When bluebirds or swallows take possession of a martin house it is a good plan to put up a one-room house in the vicinity and remove the nest from the martin house. Interlopers, thus evicted, often transfer their housekeeping to the small house. Houses designed for woodpeckers should always have an inch or so of sawdust in the bottom for the reception of eggs, as woodpeckers do not gather nest materials. Due attention should be given to repairs. It is easier to keep houses in good order than to build new ones.

ENEMIES OF HOUSE BIRDS.

Birds have numerous enemies from which a careful landlord will try to guard them. Among these is the English sparrow, whose persistent attacks too often drive more desirable birds away from their nests and from the neighborhood. Those who wish to free their premises of these sparrows will find recommendations in Farmers' Bulletin 493, The English Sparrow as a Pest. European starlings, which at present are not distributed beyond a narrow strip of the Atlantic coast

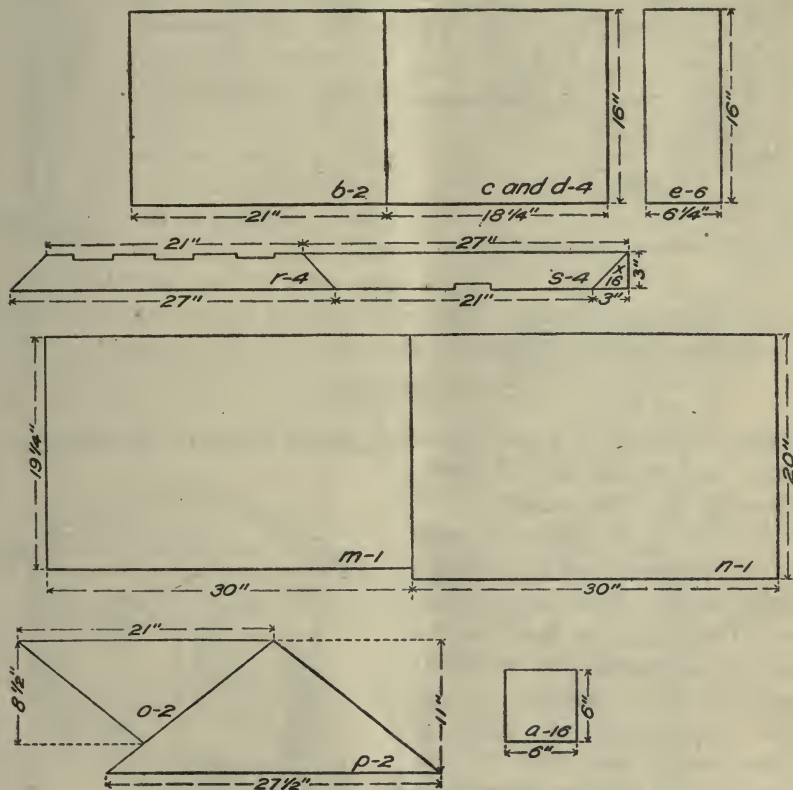


FIG. 41.—Lumber diagrams for martin house. Thickness of boards $\frac{3}{4}$ inch.

region centering about New York, are to be condemned for their pernicious interference with native house birds.

Cats and large snakes are enemies of birds, the former perhaps killing more birds than any other mammal. Trees and poles supporting houses should be sheathed with tin or galvanized iron to prevent these enemies from climbing to the nests. Squirrels give more or less trouble by gnawing houses, eating eggs, and killing nestlings. Red squirrels, in particular, have a very bad reputation in this respect, and many experimenters keep their grounds free from them. Some regard flying squirrels as but little better than red ones. Even gray

and fox squirrels are occasionally troublesome. It is not necessary, however, that bird lovers should wage indiscriminate warfare against all squirrels. It is far better to adopt the rule never to kill a squirrel unless there is reason to believe that it has acquired the habit of eating eggs or young birds; the result will probably be that not more than one red squirrel in fifty, nor more than one gray squirrel in a hundred will have to be killed. Where squirrels are numerous they give more or less trouble by gnawing and disfiguring houses.

This damage may be prevented, however, by covering the parts about the entrance with tin or zinc.

FOOD SHELTERS.

Another means of attracting birds about human habitations is to furnish an abundance of food, preferably in food shelters. If one is unable to make shelters that will protect food in all kinds of weather, the food may be fastened to trunks or branches of trees or scattered in sheltered places on the ground. A decided advantage in having shelters, aside from that of protecting food, is that they may be placed where the birds can be watched conveniently. When shelters are used the birds are first baited by placing food, such as suet, seeds, or cracked nuts, in a conspicuous place, and then led by degrees to enter the inclosure. Designs for two food shelters are exhibited in figures 42 and 46, one of which is supported by a post, the other by a tree. Structural details are shown for both. There is no bottom to either of them.

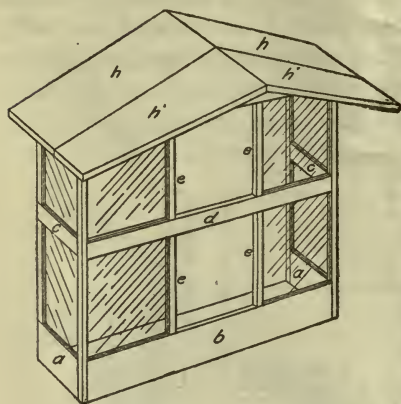


FIG. 42.—Food shelter for attachment to trunk of tree.

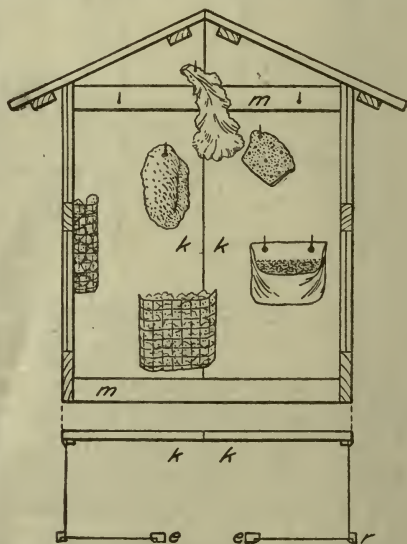


FIG. 43.—Vertical section, side to side, with suggestions for larder; diagrammatic and cross section of food shelter shown in figure 42.

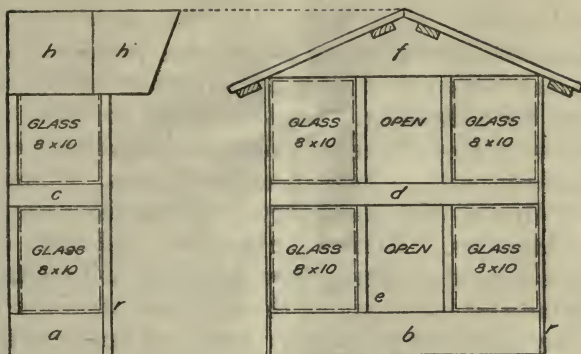


FIG. 44.—Front and side elevations of shelter shown in figure 42.

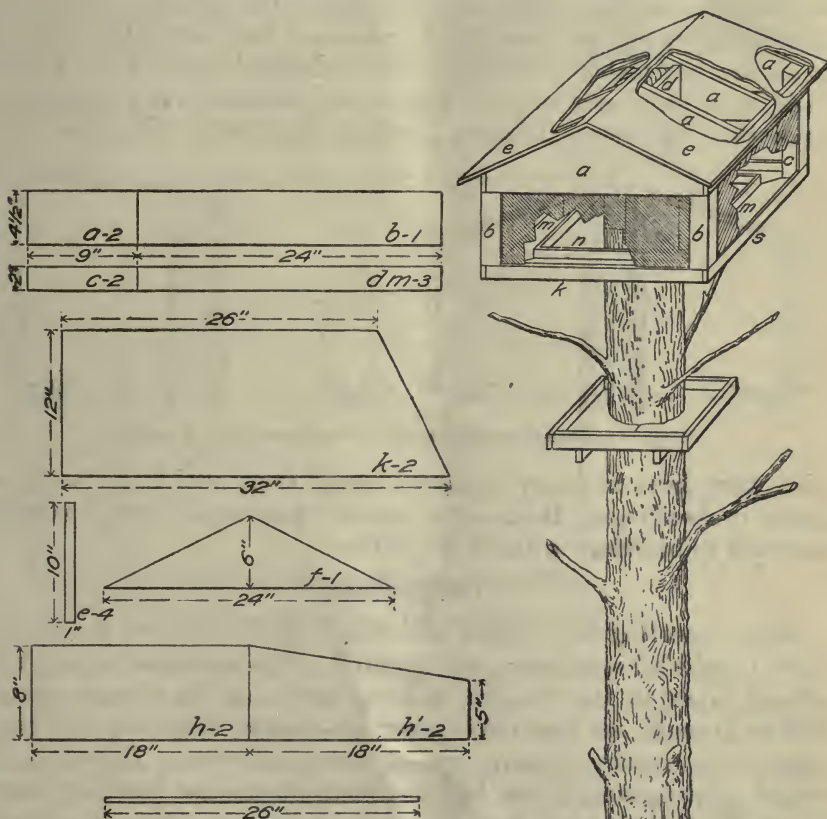


FIG. 45.—Lumber diagram of food shelter shown in figure 42.

FIG. 46.—Food shelter for attachment to post. Roof cut away to show construction. Sides made of glass; size of panes 8 by 10 inches.

LOCATION.

The location of a bird house or food shelter has much to do with its success, for the reason that birds have decided notions as to proper surroundings for a dwelling. Martins prefer to breed near houses, but not within 20 feet of trees or buildings. Bluebirds are inclined to select orchards or pastures having scattered trees. Wrens, thrashers, and catbirds live in thick shrubbery. Robins like trees with sturdy trunks and branches. Titmice, nuthatches, and most of the woodpeckers are woodland species, although flickers and red-headed woodpeckers are more at home among the scattered trees of roadsides and pastures. Song sparrows frequent weedy swales and brush fences. Swallows do not enter woods so that a house would be as attractive to them in one open place as in another. The eastern phoebe, the black phoebe, and the house finch, while not limited to the haunts of man, are noticeably partial to them. Crested flycatchers, screech owls, barn owls, and sparrow hawks are governed more by convenience than by taste; although normally inclined to hold aloof from

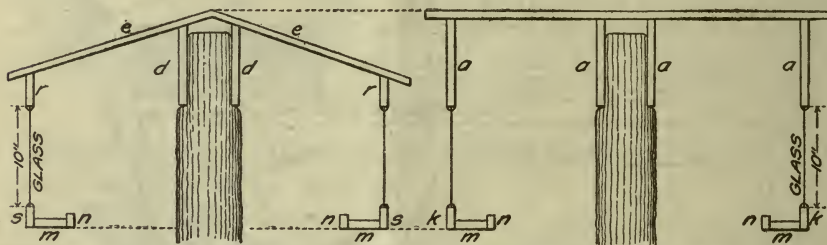


FIG. 47.—Cross and longitudinal sections of food house shown in figure 46.

man, they have in many instances reared their broods in close proximity to dwellings. Barn owls, true to their name, accept suitable quarters in buildings without hesitation.

CONCLUSION.

Before erecting bird houses one should first determine the kind of birds to which his premises are adapted. The question usually next arising is as to the number of birds that can be accommodated. Unless grounds are large, it is generally useless to expect as tenants more than a pair of each species, except martins. However, the singular intolerance shown by most birds during the breeding season to others of their kind does not operate between those of different species. A dozen different kinds of birds will pursue their several modes of hunting and raise their families on the same lot, but rarely two of the same sort.¹ Of all our house birds, martins alone are

¹ The fact that birds are more tolerant toward strangers than toward relatives was well illustrated by an observation made recently by the writer in New Mexico. A one-story tool house 10 feet square had nailed to three corners of its roof rough bird houses made from packing boxes. One was occupied by violet-green swallows, another by western bluebirds, and the third by English sparrows. A still more remarkable association of different species has been reported by Otto Widmann, of St. Louis, Mo., who once had a pair each of flickers, martins, house wrens, and English sparrows nesting simultaneously in the same house.

social. The fact that there is a limit to the possible bird population on any given tract must be taken into consideration. When the probable tenants have been decided upon, the selection of sites is in order, for the site often decides the style of house that is to occupy it. In the final placing of bird houses, care should be taken to have them

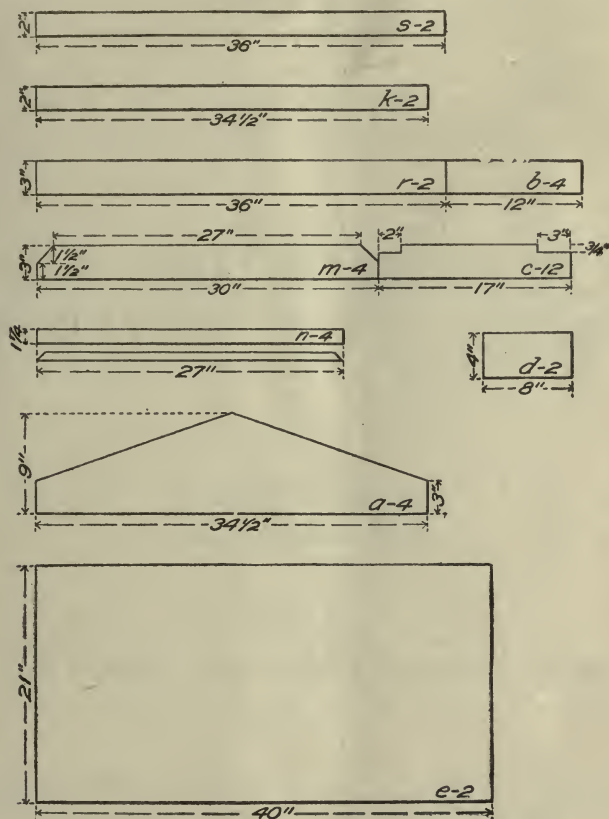
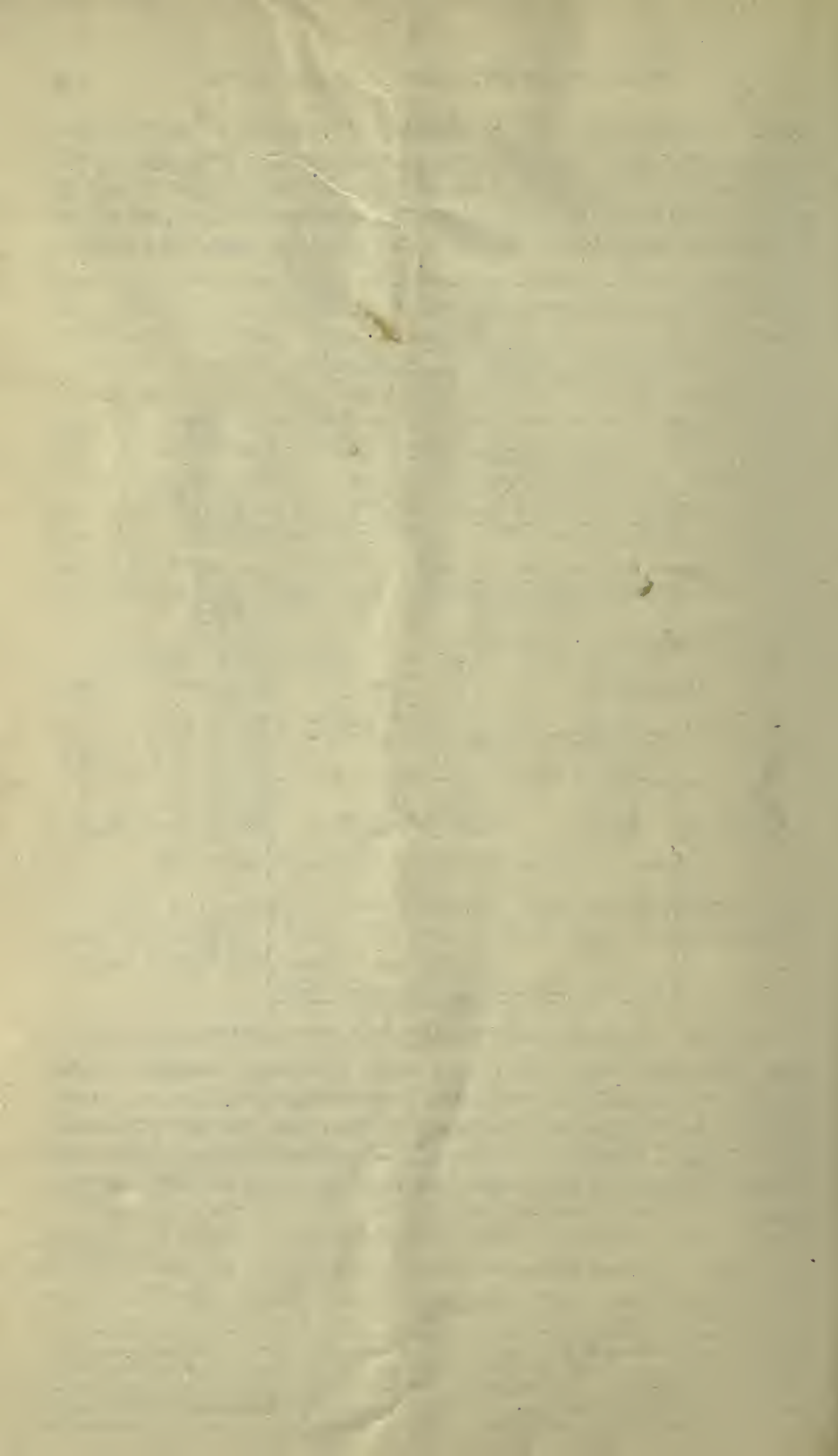


FIG. 48.—Lumber diagrams of food shelter shown in figure 46.

face away from the winds prevailing in stormy weather. The strongly developed homing instincts of birds can be relied on to attach them to the neighborhood where they first saw the light, and the identical pairs which nest in the houses provided for them one year will often return the next season to enjoy the same bounty and protection.



THE MIGRATORY MOVEMENTS OF BIRDS IN RELATION TO THE WEATHER.

By

- P -

WELLS W. COOKE,
Assistant, Biological Survey.

[FROM YEARBOOK OF DEPARTMENT OF AGRICULTURE FOR 1910.]

THE MIGRATORY MOVEMENTS OF BIRDS
IN RELATION TO THE WEATHER.

By

WILLIS H. COOPER,

Assistant, Biological Service.

[First Yearbook of the Department of Agriculture, 1900.]

CONTENTS.

	Page.
Introduction.....	379
Migration waves and temperature waves.....	379
Explanation of migration under apparently unfavorable conditions.....	381
Migration and temperature.....	382
Migration governed by average weather.....	383
Birds prefer migrating in warm weather.....	384
Birds can not foretell weather changes.....	385
Beginnings of migration.....	386
Uniformity of arrival.....	386
Fall migration.....	387
Migration and wind.....	387
Equal flight lines.....	388
Conclusion.....	390

ILLUSTRATION.

	Page.
FIG. 30. Northward migration of the summer warblers, compared with the advance of spring.....	380

CONTENTS

175	Introduction
176	Chapter I. The general principles of the theory of the
177	Chapter II. The general principles of the theory of the
178	Chapter III. The general principles of the theory of the
179	Chapter IV. The general principles of the theory of the
180	Chapter V. The general principles of the theory of the
181	Chapter VI. The general principles of the theory of the
182	Chapter VII. The general principles of the theory of the
183	Chapter VIII. The general principles of the theory of the
184	Chapter IX. The general principles of the theory of the
185	Chapter X. The general principles of the theory of the
186	Chapter XI. The general principles of the theory of the
187	Chapter XII. The general principles of the theory of the
188	Chapter XIII. The general principles of the theory of the
189	Chapter XIV. The general principles of the theory of the
190	Chapter XV. The general principles of the theory of the

ILLUSTRATION

191	Fig. 1. The general principles of the theory of the
192	Fig. 2. The general principles of the theory of the
193	Fig. 3. The general principles of the theory of the
194	Fig. 4. The general principles of the theory of the
195	Fig. 5. The general principles of the theory of the
196	Fig. 6. The general principles of the theory of the
197	Fig. 7. The general principles of the theory of the
198	Fig. 8. The general principles of the theory of the
199	Fig. 9. The general principles of the theory of the
200	Fig. 10. The general principles of the theory of the

THE MIGRATORY MOVEMENTS OF BIRDS IN RELATION TO THE WEATHER.

By WELLS W. COOKE,
Assistant, Biological Survey.

INTRODUCTION.

Accurate knowledge of the periodic movement of birds is essential as a basis for intelligent study of their economic relations, and is equally necessary for intelligent effort for the protection of migratory species—two subjects which form important parts of the work of the Biological Survey. Ever since its organization the Survey has devoted much attention to collecting data on food habits and migration, and interest in these investigations is widespread. Thus more than 2,000 observers in the United States and Canada have contributed notes on bird migration. Some of these notes cover only the dates of arrival of a few birds for a single season, others form an elaborate résumé of both spring and fall migration at a given locality for 25 years or more. The whole, aggregating more than 400,000 records, forms the largest mass of migration data ever assembled in this country.

To ascertain the relation of bird migration to the weather, two things are essential: (1) Records for many years of the times of arrival of birds, made by a thoroughly reliable and competent observer constantly in the field; (2) observations taken in a district without mountains or valleys, which might interfere with the course of migration.¹

MIGRATION WAVES AND TEMPERATURE WAVES.

In the middle of May, 1882, the whole city of Washington swarmed with large flocks of brilliantly colored birds. Scarlet tanagers, orchard orioles, and rose-breasted grosbeaks by the score flitted through the Mall and flashed among the trees of parks where ordinarily a half dozen would be a full season's quota. Rare species were common, and among them were warblers never before seen in Washington in spring. Even the Cape May, the mourning, and the

¹ In the first part of this article use has been made of the notes of Dr. J. C. Hvoslef, of Lanesboro, Minn., who contributed excellent memoranda for 10 consecutive years. His work was supplemented by that of several other observers immediately south of Lanesboro. The latter part of the article is based on the combined records of all our migration observers.

Nashville warblers, the rarest of the regular migrants, were not uncommon. What had happened? A "bird wave" had met an unfavorable "weather wave" and its progress had been temporarily arrested. It was the height of the migration season, when untold



FIG. 30.—Northward migration of the summer warblers, compared with the advance of spring.

thousands of aerial voyagers were speeding along the main chain of the Alleghenies toward their summer homes. Suddenly they were met by a sleet storm of such severity as not only to block their further northward progress, but to force them to descend from the

mountains to the shrubbery of the Coastal Plain in order to obtain food. The storm continued to the north of Washington for more than a week, while in the South fair weather tempted additional thousands to continue their migratory flight until they reached the inhospitable zone. The result was a "tidal wave" of birds never before or since equaled in the neighborhood of Washington.

This is a striking illustration of the fact that bird migration occurs in what may fitly be called "waves." Moreover, the relation of the weather to bird waves is that of cause and effect. Disconnected bird parties traveling northward are arrested by a cold snap, and succeeding swarms are similarly delayed until a great migrant host is waiting to continue its progress northward as a pronounced "bird wave."

It is not to be understood, however, that bird waves and temperature waves are always synchronous. Indeed, if a chart showing the weather waves at a given place for a series of years is compared with a similar chart showing the bird waves, the lack of uniformity is such as to suggest that there can be no relation between migration movements and the weather. Thus one season at Lanesboro, Minn., during the first week in May, the temperature was above normal and a great bird wave flooded the woods with songsters. The next year the same species came five days earlier, apparently because of a warm wave that carried the mean temperature far above the average. But the following year one of the most pronounced bird waves of the season occurred on the last day of April, when, although the temperature was far below normal, the birds arrived almost a week ahead of their usual dates; and notwithstanding the continuance of cold weather for the next three weeks, the birds kept coming, two-thirds of them earlier than usual. The largest bird wave ever recorded at Lanesboro, Minn., was on May 9, 1891, when after several days of cold the temperature rose suddenly some 20° above normal. Yet in another year the largest number of arrivals was on May 7, the last of three days of increasing cold, when the temperature was fully 20° below normal.

Evidently it is impossible to foretell what bird movements will accompany any given set of weather conditions. It may seem that a certain storm has held back the travelers, but another year, under apparently identical conditions, the birds may continue northward in spite of a storm. Birds fail to arrive when circumstances seem propitious and again come in myriads when conditions seem adverse.

EXPLANATION OF MIGRATION UNDER APPARENTLY UNFAVORABLE CONDITIONS.

The probable explanation of these wide departures from the intimate connection that has been supposed to exist between bird migra-

tion and the weather is found in the fact that migration does not progress uniformly, but is a series of advances interspersed with periods of rest or inactivity. The average daily advance of migration northward in spring in the Mississippi Valley is only 23 miles, or scarcely more than a half hour's flight; but since there are many stop-over nights on the migration journey, it follows that on each night of flight a correspondingly greater distance must be covered. Probably few night migrants make less than 100 miles at a flight, while spurts of 200 miles or more must be very common. The records of migration near the Mississippi River during one spring indicate that the purple martin made nearly the whole trip from southern Louisiana to southern Manitoba in 12 nights (120 miles a night), although 70 days were spent between the two places. A study of the weather map and of the records of the migration observers makes it probable that the fox sparrow, brown creeper, ruby-crowned kinglet, yellow-bellied woodpecker, field sparrow, and purple martin, which were noted at Lanesboro, Minn., the morning of April 1, 1888, had traveled the night before from at least as far south as Davenport and probably from Keokuk, Iowa.

It must frequently happen that migrating birds pass from auspicious into adverse weather or are caught by sudden storms and forced to alight. Next day, when they are noted as arrivals, they are recorded as having migrated during unfavorable weather, such records going to swell the percentage of exceptions to the supposed rule that birds prefer good weather for migrating.

During spring migration it is probable that birds do not start in the evening except under favorable conditions, and when these conditions hold throughout the night the flight northward is greatly prolonged. This probably explains a hitherto unnoted fact brought to light by a study of the migration data in the Biological Survey. After the northward movement has been checked and then resumed, the birds do not stop when they have made up for lost time, but keep on until they are in advance of their normal position. Several striking examples of this appear in the Lanesboro notes—in fact, examples are numerous enough to warrant the assertion that in every great migratory movement there are numerous individual birds which are ahead of their normal time.

MIGRATION AND TEMPERATURE.

On the night of March 13-14, 1904, an innumerable host of Lapland longspurs, migrating northward in southern Minnesota, encountered a heavy fall of soft, damp snow. Weighted by the clinging flakes, the birds dropped to earth, and a large proportion perished. The death toll on the hard, icy surface of two small lakes was

estimated at 750,000, while the number of lifeless bodies scattered over the 1,500 square miles of territory covered by the disaster was beyond computation. Such tragedies are fortunately rare, and yet so fickle is the spring weather that early migrants, to be successful, require constitutions hardy enough to withstand wide variations in temperature.

There is no definite temperature to which a bird is confined during migration. The insistent crescendo call of the ovenbird is associated in our minds with the full verdure of May woods, and yet the bird has been known to arrive in a snowstorm. While it prefers a temperature of about 55° F., the thermometer at the time of its appearance in southern Minnesota varies from near freezing to full summer warmth. Computations of the temperature at the time of arrival of several other common species (so well known and conspicuous that they could hardly fail to be seen as soon as they reached the home of the observer) show variations of from 14° to 37° , the average variation being 24° . During March, April, and May, in the Mississippi Valley, the thermometer rises about 1° for each two days, so that a difference of 24° would be equivalent to about 48 days' variation in the time of migration.

The later migrants are able to adapt themselves to temperatures of from 70° to 40° F., while the early ones ordinarily experience variations of from 45° to 15° , and are able to endure still greater cold. Thus the hoarse caw of the earliest crows is heard in southern Minnesota at an average temperature of 12° below freezing, and the birds can survive a sudden drop of as many degrees below zero.

MIGRATION GOVERNED BY AVERAGE WEATHER.

Birds do not migrate by chance. The habit of migration has been evolved through countless generations, and during this time birds' physical structure and habits have been undergoing a process of evolution to adapt them to the climatic conditions of their summer homes. In spring and early summer the climatic conditions are decidedly variable, and yet there must be some period that has on the average the best weather conditions for the bird's arrival. During the ages habits of migration have been developed under whose influence the bird so performs its migratory movements that on the average it arrives at the nesting site at the proper time.

The word "average" needs to be emphasized. It is the average weather at a given locality that determines the average time of the bird's arrival, and the average subsequent weather is the governing factor in deciding when the nest shall be constructed and the eggs laid. In obedience to physiologic promptings, the bird migrates at the usual average time and proceeds northward at the usual average speed unless prevented by adverse weather. But, unfortunately for

birds, these average weather conditions are interspersed with occasional drops of temperature that reduce insect-eating birds to the verge of starvation. The purple martin, being an early migrant, is peculiarly liable to such accidents. A storm in late June, 1903, in southern New Hampshire swept the air of the bird's insect prey for so long that all the young birds starved in their nesting boxes and a large proportion of the old birds perished. Conversely, birds go south in fall until they reach a district where usually they can obtain sufficient food throughout winter. But sometimes they do not go far enough to be out of reach of an exceptional blizzard. The coast of South Carolina was visited in February, 1899, by a heavy snowstorm, with the severest cold known there in two hundred years. Thousands of fox sparrows, snowbirds, and woodcock starved, and probably nine-tenths of the bluebirds and pine warblers shared their miserable fate.

The soundness in general of the birds' instincts is vindicated by the fact that all these catastrophes, appalling though they are, do not permanently diminish the bird population. Provided bad weather has not permanently reduced the food supply, the birds eventually regain their former numbers.

Take the striking case of the bluebird. The winter of 1894-95 killed off so many of the bluebirds east of the Mississippi River that in the spring of 1895 not a bluebird warble was heard in many a town where the year before there had been a full chorus. Since then their numbers have gradually increased, until now, were it not for persecution by the English sparrow, the ever-welcome bluebirds would be as numerous as ever.

BIRDS PREFER MIGRATING IN WARM WEATHER.

It is well known that migration is retarded by severe cold weather and is accelerated by unusually warm weather. The 10 years of observations at Lanesboro—the most accurate record that has ever been made in the United States—show about 50 per cent more arrivals during the warmer than during the colder days. The number of birds that migrate during periods of low temperature is, however, surprisingly large, and it might be objected that many of the birds recorded during cold days really came unnoticed during a previous warm spell, but the chances are that the errors of omission would count most heavily in the opposite direction, since shivering birds are apt to sink into silence and seclusion, while on warm days both melody and motion betray their presence.

A rise in temperature is interpreted by the birds as a signal for migrating. At the end of a cold snap that has halted the advance, the birds do not wait until the mercury rises to normal, but start north as soon as there is a marked change for the better. The Lanes-

boro records show just twice as many instances of arrival during a rising as during a falling temperature; and the average temperature of the two days before a bird arrives, when calculated for a series of years, is always less than the average temperature of the day of arrival.

Every student of bird migration has noticed that in an unusually early spring the first migrants arrive ahead of their average dates. Thus in Washington during March and April, 1910, almost every species anticipated its usual date of arrival. But it is seldom, if ever, that such untimeliness continues throughout an entire season, nor is any entire season likely to be later than usual. Indeed, seasons are such combinations of warm and cold waves that the average date of arrival for the whole migration period is remarkably uniform. At Lanesboro the average date of arrival for all species is April 25; the extremes vary less than four days, and the average variation from year to year is only a single day.

It has already been stated that each species prefers to arrive at its breeding grounds when the average temperature is within certain definite limits. Thus the Baltimore oriole arrives in southern Minnesota when the thermometer ranges around 55° F., but it does not follow that the oriole will appear in spring as soon as the temperature rises to that degree, nor that the bird never arrives before the temperature reaches that point. One spring at Lanesboro the 10 days from April 13 to 23 averaged 10° warmer than the oriole's preferred temperature, but no orioles appeared until May. Another year the Baltimore oriole appeared at Lanesboro when for two weeks the thermometer had not risen above 48° F. The point to be emphasized is that a knowledge of weather conditions in any given season is not a basis for deducing the time of arrival that season of any particular species.

BIRDS CAN NOT FORETELL WEATHER CHANGES.

One morning in October the base of the Statue of Liberty in New York Harbor was covered with the dead bodies of birds that had struck against the light during the previous night. More than 175 were picked up, and a larger number had fallen into the sea, all victims of this one light during a single night. Similar destruction occurs during each storm of the migration season. Whirled by the tempest until they lose all sense of direction, with the landmarks hidden by enveloping clouds, the birds are lured to death by a beacon light penetrating the mist. A continuous red light or a flashing intermittent light of any color does not attract them, but a steady white light is irresistible.

Nor are man's beacons the only agents destructive to migrating hosts. The night of October 10, 1906, flocks of migrants over Lake Huron were caught by a snowstorm and forced into the waves, and

according to an observer on the eastern shore 5,000 dead birds to the mile were strewn along the sands—only a part of those that perished.

The frequency of these disasters proves that birds can not foretell the weather. No bird starts on a migratory flight during a rain or in a dense fog or against a chilling blast, and yet thousands of birds each year are found near lighthouses and along the shores of large bodies of water under just such weather conditions, showing that after starting they met or were overtaken by the storm. The early settlers in the Mississippi Valley noticed so often that an exceptionally heavy flight of ducks and geese moving straight south at a high altitude was soon followed by a severe storm that they came to have great faith in the birds as weather prophets and believed that they could actually foretell an approaching tempest. It is more probable that the birds began to migrate at the first signs of the storm and outstripped it in their southward flight.

BEGINNINGS OF MIGRATION.

It may be safely stated that the weather in the winter home has nothing to do with starting birds on the spring migration, except in the case of a few, like ducks and geese, that press northward as fast as open water appears. There is no appreciable change in temperature to warn the hundred or more species of our birds which visit South America in winter that it is time to migrate. It must be a force from within that makes them spread their wings for the long flight. The most important duty of the individual bird is the perpetuation of the species, and the impulse which annually starts the bird north toward its breeding grounds is physiological.

UNIFORMITY OF ARRIVAL.

Were the surface of the earth level and the climate absolutely uniform, birds would arrive at a given place on approximately the same day each year, but the records for a series of years at any given locality show considerable variation in the dates of arrival. Part of this variation is undoubtedly due to errors of observation, for series of notes on the same species by different observers in neighboring localities often show highly improbable differences in the apparent regularity of arrival. In the records of the Biological Survey the best example of uniformity in arrival is that of the chimney swift at New Market, Va., as noted by George M. Neese. The dates of each year from 1884 to 1906 are, respectively: April 16, 16, 15, 16, 16, 11, 9, 15, 21, 14, 15, 14, 12, 7, 16, 14, 16, 12, 11, 9, 12, 12, 10. The three days, April 14, 15, and 16, include more than half the years, the average date is April 13, and the average variation from this date is only 2.2 days. Usually, however, the recorded dates of arrival of a species vary irregularly from 10 to 14 days, with an average variation of a little more than 3 days. These variations and

the date of arrival on its nesting grounds depend on the combination of storm and fair weather met during the journey.

The arrival of a migrating bird in any district south of its final goal depends not so much on the local temperature of that district as on its geographic relation to the place of nesting. The summer warblers, for instance, which nest in Manitoba, doubtless spend the winter in South America and probably start north in March, arriving in Manitoba the middle of May, where they find an average temperature of about 48° F. As this is the time they begin summer housekeeping, it is evident that these warblers obtain an abundance of food at this temperature. Leaving South America with the thermometer higher than 70° F., throughout the entire trip they are in a temperature warmer than is required for their food supply, and it is only during severe storms or unusual cold that climatic conditions delay their northward progress.

Thus over the whole flight way between the winter and summer homes, local weather conditions have little influence on the average time of the bird's arrival, except when it nears its breeding grounds. Then it approaches a critical zone, where its migration is very likely to be affected by the weather. The summer warbler usually finds in Louisiana a temperature of 70° F., and a drop of 10° would hardly retard its progress; but if, just before it reached Manitoba, the temperature should fall from 48° F. to 38° F., it would probably fold its wings and wait.

FALL MIGRATION.

The data available for the study of fall migration are much less in quantity, as well as less reliable, than those on spring migration. It may be said, however, that almost without exception the beginnings of fall migration have no relation whatever to the weather. Most species migrate as soon as the young are able to care for themselves; others begin molting then and start on their southward trip when their new fall suits are ready. Many species begin to go south in July and most of the others early in August, long before the fall storms have lessened their food supply, and, indeed, at the time when food is most plentiful.

After the tide of fall migration is in full swing, its advance is varied by alternating storms and fair weather, as in spring, but with exactly opposite effects; instead of delaying migration, a fall storm causes the departing hosts to hasten their movements before the chilling northern blasts. In spring the larger part of migration occurs with a rising temperature; in fall a still larger percentage occurs when the temperature is falling.

MIGRATION AND WIND.

During spring migration the direction of the wind seems to have little if any effect on the movements of birds. Arrivals were noted

at Lanesboro, Minn., 102 days when the wind was south, southeast, or southwest, as against 96 days when the wind was north, northeast, or northwest. Thus the birds migrated with the wind against them just about as frequently as with the wind in their favor. Observations at the lighthouses of southern Florida point to the same conclusion. The Biological Survey has the records for many years of each night in spring on which birds were noted passing the lights. These migrants had just reached Florida by a flight over the ocean from Cuba. One might expect them to wait for a favoring wind before starting to sea, but the records indicate that they paid no attention to the direction of the wind.

In fall it seems to be different, but it must be remembered that most that has been published on the interrelation of bird flights and the wind in fall refers to the late migrants, which have waited until they are forced south by the advance of winter. The larger part of fall migration occurs in late summer and early autumn, before the equinoctial storms set in and the temperature drops. There is no reason for believing that the movements of birds at this time have any more intimate relation to the direction of the wind than in spring. It is true that late migrants hurry southward with a north storm and halt on the advent of a south wind, but the real cause of the southward journey is probably the cold that accompanies the north wind.

EQUAL FLIGHT LINES.

Another question arises: Do the individuals of a given species migrate along the Atlantic slope at the same time and at the same average temperature as those in the Mississippi Valley or on the Pacific coast? Few species extend their range from ocean to ocean and are also so common and well known that sufficient data concerning them have been accumulated to permit definite deductions. But a study of several wide-ranging species makes it certain that each one is a law unto itself, and that it is not safe to reason from one species to another, even if closely related. Thus the purple martin and the cliff swallow both desert the United States during winter to sojourn in South America; both return to the United States in spring and breed from the Atlantic to the Pacific; but while the purple martin keeps approximately the same temperature in its advance along the coast and the interior, the cliff swallow moves up the Mississippi Valley at a much lower temperature than along the Atlantic coast, and, indeed, orders its movements with less relation to the progress of the season than any other bird so far studied.

The summer warbler is so abundant and well known that voluminous records of its migrations are on file in the Biological Survey. It observes a very regular spring schedule, as is shown by the accom-

panying map (fig. 30)—the first of the kind ever published in this country—giving the spring advance of the season, as shown by isotherms, in comparison with the corresponding equal flight lines or isochronal lines of the summer warbler. This bird was selected because it winters entirely south of the United States and during migration occurs from ocean to ocean and from the Gulf of Mexico to Canada. By April 10 the warbler is noted across the whole country from South Carolina to California. At this date the foremost rank of birds—the equal flight line of April 10—is closely coincident with the isotherm of 62° at the Mississippi River, slightly in advance in South Carolina and Arizona, and still farther north on the Pacific slope. These differences in the West constantly increase as the season advances.

During the 10 days from April 10 to April 20 the isochronal line of the summer warbler moves to Virginia, southern Illinois, and northern California, which brings it on April 20 approximately along the isotherm of 58° . The birds have moved north faster than the season. During the whole trip from the Gulf of Mexico to Canada, for each 10 days of the spring flight there is a remarkably uniform drop of 4° in the average temperature at which the van of migration is moving, and while the earliest migrants reach the United States when the daily mean temperature is about 60° F., those which nest in northern Canada reach their northern summer home when the daily mean temperature is below 45° F.

On April 30 the earliest summer warblers have reached northeastern Nebraska, while to the westward the van is 350 miles in the rear and is just appearing in southeastern Colorado. This retardation of migration is due to the increasing elevation of the land from the Missouri westward, which causes a decrease of temperature. On the great western plains, where the slope is about 6 feet to the mile, bird migration is retarded on the average one day for each 300 feet increase in altitude. For steeper slopes there is still greater retardation of migration relatively to the increase in altitude.

On the Pacific coast, from April 10 to 20, the summer warblers advance about as fast as the spring, but within the next 10 days they appear in southwestern British Columbia, having averaged 75 miles a day—two and one-half times the speed of those on the Atlantic slope; also in these 10 days they have gone from a temperature of 58° F. to one of 48° F., while the eastern birds were dropping from 58° F. only to 54° F.

The map shows also some interesting facts as to the route of the migration flight. All the numerous records of the summer warbler's arrival in southern Texas from San Antonio to Brownsville are later than those of northeastern Texas, showing that the early migrants reach the northeastern part of that State by a direct flight over the

Gulf of Mexico, while the late birds in southern Texas probably travel by a land route through Mexico. Similarly the dates of spring arrival are earlier in northern Georgia than in southeastern Georgia and northeastern Florida, indicating that the earliest migrants across the Gulf of Mexico fly far inland before alighting.

The summer warbler arrives at Edmonton, Alberta, earlier than at central Montana, 400 miles south. Evidently the Edmonton birds do not come from the south, neither are they from the southeast, for migration is no earlier in southern Manitoba than it is in central Alberta. Hence they must come from the southwest, though this necessitates their crossing the main range of the Rocky Mountains, which at this season is still cold and partly covered with snow.

CONCLUSION.

The foregoing facts show conclusively that weather conditions are not the cause of the migration of birds, but that the weather, by influencing the food supply, is the chief factor which determines the average date of arrival at the breeding grounds. Migration is undertaken in response to physiological changes in birds, and the date of starting, in the case of most species, bears no relation whatever to the local weather conditions in the winter home. The weather encountered en route influences migration in a subordinate way, retarding or accelerating the birds' advance by only a few days and having slight relation to the date of arrival at the nesting site.

Local weather conditions on the day of arrival at any given locality are minor factors in determining the appearance of a species at that place and time. The major factors in the problem are the weather conditions far to the southward, where the night's flight began, and the relation which that place and time bear to the average position of the bird under normal weather conditions. Many, if not most, instances of arrivals of birds under adverse weather conditions are probably explainable by the supposition that the flight was begun under favorable auspices and that late in the night the weather changed. Spring migration usually occurs with a rising temperature and the movements of autumn with a falling temperature. In each case the change seems to be a more potent factor than the absolute degree of cold.

The direction and force of the wind—except as they are occasionally intimately connected with sudden and extreme variations in temperature—seem to have only a slight influence on migration.

Another conclusion equally apparent is that neither the time of migration, the route, nor the speed of one species can be deduced from records of other species, even though closely related; in other words, each species and even each group of individuals of a species is a law unto itself.

PLANTS USEFUL TO ATTRACT BIRDS AND PROTECT FRUIT.

By



W. L. McATEE,
Assistant, Biological Survey.

[FROM YEARBOOK OF DEPARTMENT OF AGRICULTURE FOR 1909.]

CONTENTS.

	Page.
Introduction	185
Plants useful for attracting fruit-eating birds.....	185
Food plants for sparrows.....	193
Food plants for upland game birds.....	194
Plants useful for protecting cultivated fruits.....	194
Conclusion.....	196

PLANTS USEFUL TO ATTRACT BIRDS AND PROTECT FRUIT.

By W. L. MCATEE,
Assistant, Biological Survey.

INTRODUCTION.

Birds play a very important part in the economy of nature, and by their destruction of insects lend material aid in keeping the balance true. Both the farmer and the orchardist are greatly indebted to birds for the destruction of insects and weed seed, and nowhere is the nature and extent of this indebtedness more fully appreciated than in the United States. In every part of our broad land also are lovers of birds whose pleasure is in large part measured by the number of feathered acquaintances each season brings. Both for practical and esthetic reasons, therefore, there is a demand for information as to the best method of increasing the bird population in restricted areas, particularly on the farms and about homes. There is a demand also for the provisioning of large preserves for both land and water game birds and the protection of crops by cultivating seed and fruit bearing plants more useful to birds than to man.

Various other factors may be made to contribute to the success of efforts to attract birds, such as a supply of water for drinking and bathing, nesting boxes, protection from enemies, and winter feeding; but the main purpose of this article is to call attention to the plants which best serve to provide food for birds and to draw their attention away from cultivated crops.

PLANTS USEFUL FOR ATTRACTING FRUIT-EATING BIRDS.

A large variety of shrubs and trees are cultivated for ornament in the United States, but in most cases it is evident that they have been planted with no thought for the needs of birds. Our native shrubs should be utilized as far as possible, especially as many of them are not exceeded in beauty or interest by foreign plants. Furthermore, as a rule they are more attractive to birds than exotics. It should be borne in mind also that smoothly trimmed hedges and the stiff trees of a formal garden are not nearly so attractive to birds as untrained bushes and tangled thickets. Shrubs of sterile varieties or those closely pruned after blooming are not sought by birds, while those allowed to ripen fruit are often crowded with feathered visitors. Moreover, plants clustered with fruit of varying color are

more beautiful and interesting than those which exhaust their energy in one burst of bloom and are of monotonous appearance thereafter.

The best shrubs and trees for attracting birds are those most resorted to for food, and the extensive records of bird food in the Biological Survey make their selection an easy task. The berries of elders (*Sambucus*) are eaten by the largest number of species of birds, namely, 67. Raspberries and blackberries (*Rubus*) are known to be eaten by 60 species, mulberries (*Morus*) by 48, dogwood fruits (*Cornus*) by 47, those of the nonpoisonous sumachs^a (*Rhus*) by 44, the various wild cherries (*Prunus*) by 39, and blueberries (*Vaccinium*) by 37. This completes the list of fruits known to be chosen by more than 30 species of birds. Following these in order are wild grapes (*Vitis*), eaten by 29 species; pokeberries (*Phytolacca*), by 26; Virginia creeper berries (*Psedera*), bayberries (*Myrica*), and juniper berries (*Juniperus*), by 25 species each; service or June berries (*Amelanchier*), by 20; holly berries (*Ilex*), by 19; strawberries (*Fragaria*) and fruits of viburnums, by 16 each; hackberries (*Celtis*) and huckleberries (*Gaylussacia*), by 15 each; haws (*Crataegus*), by 12; spicebush berries (*Benzoin*) and rose hips (*Rosa*), by 11 each; and the fruits of sarsaparilla (*Aralia*), sour gum (*Nyssa*), gooseberries and currants (*Ribes*), and snowberry (*Symphoricarpos*), each eaten by 10 species of birds.

In addition to the plants recommended on the basis of proved preference by birds, as indicated by stomach examination, there are several other genera known to furnish much bird food, or which are important in certain regions where none of the plants just mentioned are abundant. Separation of this list from the above by no means indicates inferiority for the purpose of attracting birds, but is done only to emphasize the different criteria for selecting them. These plants are: Manzanita (*Arctostaphylos*); barberry (*Berberis*); buffalo berry (*Shepherdia*); silverberry (*Elaeagnus*); buckthorn (*Rhamnus*); mountain ash (*Pyrus*); china berry (*Melia*); the California Christmas berry (*Heteromeles arbutifolia*); the pepper tree (*Schinus molle*), the fruit of which is a splendid bird food in southern California; magnolia, the pulp-coated seeds of which furnish one of the most nutritious and eagerly sought foods of birds wintering in the Southeastern States; and nockaway (*Ehretia*), lote bush (*Zizyphus*), and bluewood (*Condalia*), three favorite genera of the Southwest, where most of the plants previously mentioned are wanting.

^a It must not be understood that birds avoid the poisonous sumachs—in fact they feed upon them more extensively than upon the innocuous ones. But these plants, which are poisonous to so many people, can not, for obvious reasons, be recommended for cultivation. Another favorite bird food which it is undesirable to propagate is mistletoe.

Species of the genera listed can be selected that furnish adequate bird shelter and also a continuous supply of fruit throughout the year in any part of the United States where cultivation of trees and shrubs is practicable. It is most important to have a sure supply of bird food for late winter and early spring. The quantity of natural food is then smallest, and frequently the few remaining sources are rendered inaccessible by snow and sleet. It is advisable, therefore, for bird lovers to make liberal use of plants which retain their fruit through the winter. They will be well repaid, for a dependable food supply is never a more potent bait than at this bleak season. Among the plants much patronized by birds, those which hold their fruit longest are juniper, bayberry, hackberry, barberry, magnolia, mountain ash, rose, Christmas berry, china berry, pepper tree, sumach, holly (*Ilex opaca*), black alder (*Ilex verticillata*), certain wild grapes (notably the frost grape, *Vitis cordifolia*), manzanita, snowberry, and some evergreen species in other genera, such as the evergreen blueberry (*Vaccinium ovatum*) of the Pacific coast region, farkleberry (*Vaccinium arboreum*), and evergreen cherry (*Prunus caroliniana*) of the Southeastern States. In some localities the Virginia creeper holds its fruit, in others dropping it readily.

The plants with persistent fruit bridge the gap between the overwhelming abundance of autumn and the scarcity of early spring. Before the last of the wintered-over fruit disappears, a few plants have blossomed and begin to mature the first fruits of another season. Among the earliest of all and greatly relished by birds, are mulberries. They ripen in April—even in late March in southern localities—and in May and June farther north. Red-berried elder and service berries are but little later; often the latter are not left on the trees by the hungry birds long enough to ripen. Wild strawberries, raspberries, and dewberries are early and may be used to protect cultivated species. Certain kinds of cherries, as the European bird cherry (*Prunus padus*) and the mahaleb or stock cherry (*Prunus mahaleb*), ripen their fruit at about the same time as domestic cherries and will serve to divert the attention of birds. From the time summer is well started there is a constant abundance of wild fruits. Blueberries, huckleberries, certain dogwoods, viburnums, and grapes are among the first to ripen and fall, while sarsaparilla, elder, gooseberries, currants, spicebush, and sassafras are somewhat more persistent. Other dogwoods, silverberry, sour gum, and black cherry hold their fruit a little later, and pokeberry, hawthorn, buffalo berry, some wild grapes, and viburnums retain their fruit well into the winter, though they seldom last as well as the characteristic winter fruits named above.

Evidently there need be no season without its fruit if judicious selection of shrubs and trees is made by those desiring to attract birds. Thus a thicket of raspberry or dewberry, elder, and dog-

wood, grouped about some taller sumac, Juneberry, and juniper, would supply fruit throughout the year. Moreover, in almost any part of the United States, this combination can be made by the use of native species alone.

The problem that confronts the prospective planter of trees and shrubs to attract birds is the selection of the species most suitable for his particular locality. By reference to the descriptions below it is possible in most cases to determine the life zone to which his locality belongs. Then, from the corresponding list of trees and shrubs (given below) the species best suited to that area may be learned. The lists are by no means complete; usually but a single species of a genus is mentioned, when perhaps half a dozen or more are available. It is attempted, however, in every case to name the most satisfactory species, having due regard to its value as bird food and to its wide distribution and hardiness in the area named.

The Canadian zone is the warmest or southernmost division of the Boreal region and the most northerly life zone of agricultural importance. It "comprises the southern part of the great transcontinental coniferous forest of Canada, the northern parts of Maine, New Hampshire, and Michigan, a strip along the Pacific coast reaching as far south at least as Cape Mendocino, in California, and the greater part of the high mountains of the United States and Mexico. In the East it covers the Green Mountains, Adirondacks, and Catskills, and the higher mountains of Pennsylvania, West Virginia, Virginia, western North Carolina, and eastern Tennessee. In the mountains of the West it covers the lower slopes in the north and the higher slopes in the south. In the Rocky Mountain region it appears to reach continuously from British Columbia to west central Wyoming; and in the Cascade Range, from British Columbia to southern Oregon, with a narrow interruption along the Columbia River."^a

Plants useful for attracting birds in that part of the Canadian zone east of the Rocky Mountains are:

Juniper (*Juniperus communis*), black currant (*Ribes lacustre*), mountain ash (*Pyrus americana*), Juneberry (*Amelanchier canadensis*), blackberry (*Rubus canadensis*), red raspberry (*Rubus strigosus*), choke cherry (*Prunus virginiana*), bird cherry (*Prunus pennsylvanica*), sumach (*Rhus glabra*), buffalo berry (*Shepherdia canadensis*), sarsaparilla (*Aralia nudicaulis*), bearberry (*Arctostaphylos uvaursi*), dwarf bilberry (*Vaccinium cespitosum*), hobble bush (*Viburnum alnifolium*), red osier (*Cornus stolonifera*), and elders (*Sambucus canadensis* and *S. pubens*).

In the Rocky Mountain region and westward the following species are available:

Western juniper (*Juniperus occidentalis*), currant (*Ribes viscosissimum*), mountain ash (*Pyrus sitchensis*), service berry (*Amelanchier alnifolia*), evergreen blackberry (*Rubus vitifolius*), cherry (*Prunus emarginata*), buckthorn

^a Merriam, C. Hart. Life Zones and Crop Zones of the United States, Bull. 10, Biological Survey, p. 19, 1898.

(*Rhamnus alnifolia*), the same bearberry, bilberry, red osier, and buffalo berry as above, snowberry (*Symphoricarpos acutus*), and elder (*Sambucus melanocarpa*).

"The Transition zone * * * is the transcontinental belt in which Boreal and Austral elements overlap. From New England to the northern Rocky Mountains its course is fairly even and regular, but west of the Great Plains it is tortuous and irregular. The zone as a whole is characterized by comparatively few distinctive animals and plants, but rather by the occurrence together of southern species which here find their northern limit and northern species which here find their southern limit. It may be subdivided into three faunal areas, which, although grading into one another, are in the main strikingly different: (a) An eastern humid or *Alleghenian area*; (b) a *western arid area*; (c) a *Pacific coast humid area*. * * *

"The eastern humid or Alleghenian area comprises the greater part of New England, southeastern Ontario, New York, Pennsylvania, Michigan, Wisconsin, Minnesota, eastern North Dakota, northeastern South Dakota, and the Alleghenies from Pennsylvania to Georgia."^a

In the Alleghenian faunal area the following species of fruit-bearing shrubs may be used to attract birds:

Red cedar (*Juniperus virginiana*), mulberry (*Morus rubra*), pokeberry (*Phytolacca decandra*), barberry (*Berberis vulgaris*), sassafras (*Sassafras variifolium*), spice bush (*Benzoin aestivale*), black currant (*Ribes floridum*), mountain ash (*Pyrus americana*), service berry (*Amelanchier canadensis*), blackberry (*Rubus villosus*), raspberries (*Rubus occidentalis* and *R. strigosus*), black cherry (*Prunus serotina*), choke cherry (*Prunus virginiana*), sumach (*Rhus glabra*), black alder (*Ilex verticillata*), buckthorn (*Rhamnus caroliniana*), Virginia creeper (*Pseuderacem quinquefolia*), frost grapes (*Vitis cordifolia* and *V. vulpina*), fox grape (*Vitis labrusca*), sarsaparilla (*Aralia nudicaulis*), dogwood (*Cornus alternifolia*), bearberry (*Arctostaphylos uvaursi*), dangleberry (*Gaylussacia frondosa*), blueberries (*Vaccinium corymbosum* and *V. pennsylvanicum*), snowberry (*Symphoricarpos racemosus*), sheepberry (*Viburnum lentago*), and elders (*Sambucus canadensis* and *S. pubens*).

"The western or arid division of the Transition zone comprises the western part of the Dakotas, northern Montana east of the Rocky Mountains, southern Assiniboia, small areas in southern Manitoba and Alberta, the higher parts of the Great Basin and the plateau region generally (except the Boreal Mountains), the eastern base of the Cascade-Sierra system, and local areas still farther west, in Oregon and California, where it merges into the humid Pacific Coast division."^b

The sage hen, sharp-tailed grouse, and green-tailed towhee are characteristic birds; that is, their range is practically confined to the arid Transition area. Many other species occur, however, and those desiring to attract them will find the following shrubs and vines serviceable:

Juniper (*Juniperus scopulorum*), barberry (*Berberis repens*), currant (*Ribes cereum*), service berry (*Amelanchier florida*), red raspberry (*Rubus strigosus*), choke cherry (*Prunus demissa*), aromatic sumach (*Rhus trilobata*), grape

^a Merriam, C. Hart. Life Zones and Crop Zones of the United States, Bull. 10, Biological Survey, p. 20, 1898.

^b Ibid., p. 25.

(*Vitis californica*), silverberry (*Elæagnus argentea*), buffalo berry (*Shepherdia argentea*), red osier (*Cornus stolonifera*), snowberry (*Symphoricarpus racemosus*), and elder (*Sambucus glauca*).

"The humid Pacific Coast division of the Transition zone comprises the western parts of Washington and Oregon between the coast mountains and the Cascade Range, parts of northern California, and most of the coast region of California from near Cape Mendocino southward to the Santa Barbara Mountains. To the south and east it passes into the arid Transition, and in places into the Upper Sonoran."^a

The Pacific Coast Transition faunal area produces a wealth of fruit-bearing shrubs, among which the following are suitable for attracting birds:

Bayberry (*Myrica californica*), red flowering currant (*Ribes sanguineum*), service berry (*Amelanchier florida*), evergreen blackberry (*Rubus vitifolius*), blackcap (*Rubus leucodermis*), cherry (*Prunus emarginata villosa*), buckthorn (*Rhamnus californica* and *R. purshiana*), dogwood (*Cornus occidentalis* and *C. glabrata*), manzanita (*Arctostaphylos tomentosa*, *A. glandulosa*, and *A. canescens*), evergreen blueberry (*Vaccinium ovatum*), snowberry (*Symphoricarpus racemosus*), and elder (*Sambucus glauca*).

"The Upper Austral zone may be divided into two large and important faunal areas—an eastern humid or Carolinian area and a western arid or Upper Sonoran area, which pass insensibly into one another in the neighborhood of the one hundredth meridian. * * *

"The Carolinian faunal area * * * occupies the larger part of the Middle States, except the mountains, covering southeastern South Dakota, eastern Nebraska, Kansas, and part of Oklahoma: nearly the whole of Iowa, Missouri, Illinois, Indiana, Ohio, Maryland, and Delaware; more than half of West Virginia, Kentucky, Tennessee, and New Jersey; and large areas in Alabama, Georgia, the Carolinas, Virginia, Pennsylvania, New York, Michigan, and southern Ontario. On the Atlantic coast it reaches from near the mouth of Chesapeake Bay to southern Connecticut and sends narrow arms up the valleys of the Connecticut and Hudson rivers. A little farther west another slender arm is sent northward, following the east shore of Lake Michigan nearly or quite to Grand Traverse Bay. These arms, like nearly all narrow northward prolongations of southern zones, do not carry the complete faunas and floras of the areas to which they belong, but lack certain species from the start and become more and more dilute to the northward till it is hard to say where they really end. Their northern boundaries, therefore, must be drawn arbitrarily or must be based on the presence or absence of particular species rather than the usual association of species."^b

Native shrubs and trees useful for attracting birds in the Carolinian faunal area are:

Red cedar (*Juniperus virginiana*), bayberry (*Myrica cerifera* and *M. carolinensis*), hackberry (*Celtis occidentalis*), mulberry (*Morus rubra*), pokeberry (*Phytolacca decandra*), sassafras (*Sassafras variifolium*), spice bush (*Benzoin astivale*), black currant (*Ribes floridum*), Juneberry (*Amelanchier canadensis*),

^a Merriam, C. Hart. Life Zones and Crop Zones of the United States, Bull. 10, Biological Survey, p. 27, 1898.

^b Ibid., pp. 30-31.

blackberry (*Rubus villosus*), raspberry (*Rubus occidentalis*), black cherry (*Prunus serotina*), sumach (*Rhus glabra* and *R. copallina*), black alder (*Ilex verticillata*), buckthorn (*Rhamnus caroliniana*), Virginia creeper (*Pseuderacera quinquefolia*), frost grape (*Vitis vulpina*), summer grape (*Vitis aestivalis*), fox grape (*Vitis labrusca*), sarsaparilla (*Aralia nudicaulis*), dogwood (*Cornus asperifolia*, *C. florida*, and *C. alternifolia*), sour gum (*Nyssa sylvatica*), dangleberry (*Gaylussacia frondosa*), blueberries (*Vaccinium corymbosum* and *V. vacillans*), snowberry (*Symphoricarpos racemosus*), viburnum (*Viburnum acerifolium* and *V. prunifolium*), and elder (*Sambucus canadensis*).

"The Upper Sonoran faunal area * * * of the Western States and Territories is the arid-land continuation of the Carolinian area of the more humid Eastern States. * * * Beginning in the neighborhood of the one hundredth meridian, it covers most of the great plains in eastern Montana and Wyoming, southwestern South Dakota, western Nebraska, Kansas, Oklahoma, and Texas, and eastern Colorado and New Mexico. In Oregon and Washington it covers the plains of the Columbia and the Malheur and Harney plains; in California it encircles the Sacramento and San Joaquin valleys and forms a narrow belt along the eastern boundary of the Colorado and Mohave deserts; in Utah it covers the Salt Lake and Sevier deserts; in Idaho, the Snake Plains; and in Nevada and Arizona, irregular areas of suitable elevation."^a

The following plants are recommended for use in this region:

Juniper (*Juniperus monosperma* and *J. californica*), hackberry (*Celtis reticulata*), mulberry (*Morus rubra*), barberry (*Berberis fendleri*), golden currant (*Ribes aureum*), service berry (*Amelanchier utahensis*), red raspberry (*Rubus strigosus*), choke cherry (*Prunus demissa*), aromatic sumach (*Rhus trilobata*), buckthorn (*Rhamnus tomentella* and *R. smithi*), Virginia creeper (*Pseuderacera quinquefolia*), red osier (*Cornus stolonifera*), manzanita (*Arctostaphylos manzanita* and *A. viscida*), snowberry (*Symphoricarpos racemosus*), and elder (*Sambucus glauca*).

"The Lower Austral zone occupies the southern part of the United States, from Chesapeake Bay to the great interior valley of California. It is interrupted by the Continental Divide in eastern Arizona and western New Mexico, and is divided, according to conditions of humidity, into an eastern or *Austroriparian* and a western or *Lower Sonoran* area.

* * * "The Lower Sonoran area begins with the arid region of Texas in the neighborhood of longitude 98°, and stretches westward to the Rio Grande Valley, in which it sends an arm northwest to a point a little north of Albuquerque, N. Mex. Another arm reaches up the valley of the Pecos. West of the Rio Grande Valley in New Mexico the Lower Sonoran is interrupted by the Continental Divide. *It begins again in eastern Arizona and sweeps broadly westward below the high plateau, covering southern and western Arizona, the deserts of southern Nevada and eastern California, and the San Joaquin and Sacramento valleys."^b

The Lower Sonoran faunal area has few native fruit-bearing shrubs and trees, but some of them are of more than ordinary value as bird food. The following, including several extralimital species

^a Merriam, C. Hart. Life Zones and Crop Zones of the United States, Bull. 10, Biological Survey, p. 36, 1898.

^b Ibid., p. 41.

tested by the New Mexico Agricultural Experiment Station (and distinguished by an asterisk), are recommended:

Hackberry (*Celtis reticulata** and *C. pallida*), barberry (*Berberis hamatocarpa** and *B. trifoliata*), golden currant (*Ribes aureum**), cherry (*Prunus copallina**), sumach (*Rhus mexicana* and *R. microphylla*), bluewood (*Condalia obovata*, *C. obtusifolia*, and *C. spathulata*), lote bush (*Zizyphus obtusifolius*), grape (*Vitis arizonica*), Virginla creeper (*Psedera quinquefolia**), nockaway (*Ehretia elliptica*), elders (*Sambucus mexicana** and *S. glauca*), *Lycium berlandieri* and *andersoni*, and some of the pad cactuses, notably *Opuntia engelmanni* and *lindheimeri*.

"The Austroriparian area occupies the greater part of the South Atlantic and Gulf States. Beginning near the mouth of Chesapeake Bay it covers half or more than half of Virginia, North and South Carolina, Georgia, Florida, Alabama, the whole of Mississippi and Louisiana, eastern Texas, nearly all of Indian Territory, more than half of Arkansas, and parts of Oklahoma, southeastern Kansas, southern Missouri, southern Illinois, the extreme southwestern corner of Indiana, and the bottom lands of western Kentucky and Tennessee."^a

"The Gulf strip, or southern part of the Austroriparian area, reaches from Texas to southern Florida, covers a narrow strip in southern Georgia, and probably follows the coastal lowlands northward into South Carolina."^b

For the purposes of this article the whole Austroriparian faunal area, including the Gulf strip, may be considered together as the humid division of the Lower Austral, all of which lies east of the one hundredth meridian. In this region many cultivated plants thrive that do so nowhere else in the eastern United States, and some of them are valuable for attracting birds. But there are plenty of native fruit-bearing shrubs and trees also, of which the following are recommended:

Red cedar (*Juniperus virginiana*), bayberry (*Myrica cerifera*), hackberry (*Celtis occidentalis* and *C. mississippiensis*), mulberry (*Morus rubra*), magnolia (*Magnolia grandiflora* and *M. virginiana*), sassafras (*Sassafras variifolium*), spicebush (*Benzoin æstivale*), dewberry (*Rubus trivialis*), black cherry (*Prunus serotina*), evergreen cherry (*Prunus caroliniana*), sumach (*Rhus copallina* and *R. glabra*), holly (*Ilex opaca*), buckthorn (*Rhamnus caroliniana*), Virginia creeper (*Psedera quinquefolia*), grape (*Vitis vulpina* and *V. æstivialis*), pepper vine (*Ampelopsis arborea*), hercules club (*Aralia spinosa*), dogwood (*Cornus asperifolia* and *C. florida*), sour gum (*Nyssa sylvatica*), huckleberry (*Gaylussacia dumosa*), farkleberry (*Vaccinium arboreum*), blueberry (*Vaccinium corymbosum*), viburnum (*Viburnum rufotomentosum* and *V. nudum*), and elder (*Sambucus canadensis*).

Besides native shrubs and trees, a number of cultivated species have proved so attractive to birds that they are as important as any of the indigenous fruits. An excellent example is the pepper tree (*Schinus molle*), which flourishes in southern California, and which will probably thrive in many other parts of the Lower Sonoran faunal area. Others suited to the same climate are the china berry

^a Merriam, C. Hart. Life Zones and Crop Zones of the United States, Bull. 10, Biological Survey, p. 45, 1898.

^b Ibid., p. 49.

(*Melia azedarach*), the Russian mulberry (*Morus alba tatarica*), and the Russian oleaster (*Elæagnus angustifolia*). The china berry is just as successful in the eastern part of this zone, namely, in the Austroriparian faunal area; it retains its fruit through the winter and is eagerly sought by robins, cedar birds, and catbirds. The Russian oleaster and another species (*Elæagnus umbellata*) also do well here and furnish an abundance of fruit relished by birds. *Elæagnus angustifolia* and *Melia* are hardy at Washington, D. C., also, which is in the Upper Austral zone. The fire thorn (*Cotoneaster pyracantha*), a beautiful shrub with scarlet berries much liked by birds, will grow almost anywhere in the eastern United States, and the Parkman apple (*Pyrus halliana*), one of the handsomest flowering apples, is quite hardy, and is a valuable bird food, with fruit persistent in winter. But foremost in attractiveness to birds among cultivated fruit-bearing plants are mulberries. These will grow almost anywhere in the United States, and their combined early ripening and long fruiting season make them especially valuable. Varieties of mulberries suited to the various faunal areas will be treated at greater length in the section devoted to plants useful for protecting cultivated crops.

FOOD PLANTS FOR SPARROWS.

A hundred species of sparrows inhabit the United States, and in the number of individuals they outrank any other family. Many of them are characteristic winter birds, and as they are great destroyers of weed seeds and are sprightly and cheery withal, it pays to take considerable trouble to attract them.

As just remarked, they love weed seeds and do great good by destroying them; but as it is not desirable to cultivate weeds, the next best thing is to plant harmless species of their favorite genera. Fortunately many common ornamental garden plants which are entirely dependent on cultivation fulfill all requirements and produce in abundance seeds which are highly relished by sparrows. To these may be added a few native species which are not bad weeds, and the various millets, which are excelled by no other plants in attractiveness to seed-eating birds. The following are recommended for sparrows and other birds liking small seeds:

Love-lies-bleeding (*Amaranthus candatus*), princes feather (both *Amaranthus hypochondriacus* and *Polygonum orientale*), yellow chamomile (*Anthemis tinctoria*), chamomile (*Anthemis nobilis*), Calandrinia (*umbellata*), bachelors button (*Centaurea cyanus*), African millet (*Eleusine coracana*), California poppy (*Eschscholzia californica*), tarweed (*Madia elegans*), miners lettuce (*Montia perfoliata*), millet (*Panicum miliaceum*), Japan barnyard millet (*Panicum crusgalli* var.), German millet or Hungarian grass (*Setaria italica*), and sunflower. Several of the species of sunflower will serve, the common sunflower (*Helianthus annuus*) being one of the best, having named varieties especially prized for the abundance and large size of the seed. No seeds are more relished by graminivorous birds than the millets; in fact, they are so much preferred that they have been used with good effect for drawing the attention of birds from more valuable grain crops.

FOOD PLANTS FOR UPLAND GAME BIRDS.

The distinction between the dietaries of the so-called frugivorous and graminivorous birds is not so marked as would be inferred from a strict interpretation of these terms. Particularly in the case of the grouse and quail does a limited characterization of the food habits fail to express the truth. Consequently in recommending plants attractive to these birds many must be mentioned that are included in the lists for fruit-eating birds. Grouse are fond of both buds and leaves; hence some plants which have neither nutritious fruit nor seeds are for them important food plants.

While the establishment of preserves for land game birds is yet a new movement in this country, it is certain to become of great importance. Hence it is desirable to disseminate information as to the food and covert plants that are favored by the grouse and quail. Bobwhites frequently use covers of rose, alder, and blackberry bushes, and thickly set barberry, bayberry, and dense banks of honeysuckle are suitable. These plants also furnish food for the birds, but they should be supplemented by others more exclusively adapted for this purpose. Sumach, Japanese clover, buckwheat, sorghum, millet, vetches, cowpeas, and any plants of the pea family producing small seeds are valuable, and should be sown in large quantities. The seeds of milk pea (*Galactia*), partridge pea (*Chamæchrista*), hog peanut (*Falcata*), wild bean (*Strophostyles*), and smartweeds (*Polygonum*) are important natural foods of the eastern quail, but should be encouraged only where they can not become weed pests. The western quail are fond of the seeds of sumach, bur clover, alfilaria, lupines, napa thistle, and turkey mullein plants; but where these plants are liable to become nuisances the food plants recommended for the eastern quail will serve.

Coverts for grouse, as the sharptail, should abound in such plants as rose, sumach, blueberry, bearberry, buffalo berry, dwarf birch, and alder. The ruffed grouse thrives among scrub oak, bayberry, rose, sumach, dwarf birch, alder, poplar, willow, and such fruit-bearing plants as partridge berry, hawthorn, viburnum, wild grapes, mountain ash, blueberry, blackberry, and cranberry. Cover of this nature is suited to the heath hen also, and to the imported pheasants and the Hungarian partridge, but in all cases it is well to supplement the food supply furnished by these shrubs and trees by planting small grains and legumes as recommended for quail.

PLANTS USEFUL FOR PROTECTING CULTIVATED FRUITS.

The practice of planting wild or inferior fruits for the purpose of tolling birds away from valuable cultivated varieties is very old, but it has never been tried as widely and systematically as seems desirable.

The chief essential to the success of this plan is that the decoy trees shall be early bearing species, for almost all of the damage to fruit by birds is inflicted on the earliest varieties, evidently because of the scarcity of early wild fruit. Probably cherries, raspberries, and strawberries suffer more in the aggregate than all of the later fruits. Fortunately we have a fruit which fills this need, one which ripens with the earliest cherries and is a favorite with all frugivorous birds, namely, the mulberry, both native and cultivated.

Three varieties of the native mulberry (*Morus rubra*), namely, the Hicks, Stubbs, and Townsend, are especially successful in the Southern States, though the Hicks is known to thrive in the Carolinian faunal areas and Stubbs in the Alleghenian. The Townsend is a comparatively new variety and its hardiness is unknown, but it ripens fruit remarkably early and should be given a thorough trial. According to Prof. L. H. Bailey, the New American (often sold under the name Downing) is the best mulberry known for the Northern States. The Russian mulberry is the hardiest variety and is a favorite in the plains region and other places where great extremes of temperature prevail. It succeeds in as diverse climates as those of North Dakota and New Mexico. The New American, Russian, and Black Persian mulberries are known to do well in California, and the indications are that the latter is suited to conditions in the Lower Sonoran faunal area. When planting mulberries for the purpose of protecting cultivated fruits, the earliest fruiting varieties obtainable should be used.

Among fruits suitable for the same purpose, but not now known to be as valuable as mulberries, are the mahaleb or stock cherry (*Prunus mahaleb*) and the European bird cherry (*Prunus padus*). Among native fruits the only ones that can be recommended at present are the service berry or Juneberry (*Amelanchier*), redberried elder (*Sambucus pubens*), and wild strawberries and raspberries. Patches of the earliest varieties of these small berries are very attractive to birds.

Injury to later fruits, except in localities where there are no wild fruits, is more difficult to prevent, as in such cases it probably arises from preference by the birds for a particular cultivated fruit. Thus grapes suffer seriously in some places. The always reliable mulberries are useful even at this season, as some varieties continue in bearing from two to six months. Elderberries are probably the most valuable native fruit for attracting birds in the summer and fall, particularly in the West, where they have a long fruiting season. In the North and East no summer fruits are more attractive to birds than the black cherry (*Prunus serotina*) and choke cherry (*Prunus virginiana*),

CONCLUSION.

Nothing surpasses mulberries for alluring birds away from the early orchard fruits. Early bearing varieties should be planted in numbers and some should be selected for the length of the fruiting season. The Hicks and the Black Persian are notable in the latter respect, while the Townsend is earliest for the South and the Russian for the North.

Where it is desired to attract birds and afford them a sanctuary at all seasons, a large variety of plants must be used. For this purpose thickets of shrubs and other low growths are better than trees, since tangles of bushes and vines afford a more secure retreat from bird enemies and are the favorite cover of many species.

Where birds occur in large numbers their enemies are sure to congregate. Hence grounds especially designed to attract birds should also be furnished with devices to insure security from cats and other predatory animals. Fences made proof against climbing invaders by overhanging wire netting are essential, and inverted funnel-shaped metal guards or loose spirals of barbed wire should be placed around the trunks of nest trees to protect the occupants. Bird houses of various types add to the possibilities of bird gardens, and a never-failing supply of water is an essential. The basin should be shallow, so as to serve both for bathing and drinking, and should be placed in an open lawn or elevated so that birds resorting to it will not be at the mercy of enemies. Assured safety and a plentiful supply of food and drink will work wonders in attracting birds.



PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

R

DESCRIPTION OF A NEW MELOSPIZA FROM
CALIFORNIA.

BY HARRY C. OBERHOLSER.

A series of song sparrows from eastern California, in the Biological Survey Collection, United States National Museum, appear to represent an undescribed race. Since several of these specimens were obtained by Dr. A. K. Fisher, in Owen Valley, California, during the Death Valley Expedition of 1891,* this new form may appropriately be named

Melospiza melodia fisherella subsp. nov.

Chars. subsp..—Similar to *Melospiza melodia heermanni* Baird, but larger; upper surface paler, less rufescent; streaks on lower parts less blackish (more brownish).

Type.—Adult male, No. 203,507, U. S. Nat. Mus., Biological Survey Collection; Honey Lake, near Millford, California, June 18, 1906; A. S. Bunnell.

Description of type.—Upper surface somewhat rufescent hair brown; the crown with broad lateral stripes of burnt umber, and throughout with streaks of clove brown; the back and scapulars broadly streaked with black and burnt umber; the rump and upper tail-coverts somewhat streaked with dark brown; tail sepia, edged externally with wood brown and dull russet; wing-quills grayish sepia, margined exteriorly with wood brown and dull russet; superior wing-coverts mostly burnt umber, margined more or less with pale hair brown, the median and greater series and the tertials with terminal shaft markings of black or clove brown; superciliary stripe, auriculars, and sides of neck ash gray, the first mentioned paler than the others; postocular and malar stripes burnt umber; entire lower surface, including inferior wing-coverts, dull white, the sides, flanks, and crissum washed with brownish or buffy; breast, jugulum, sides, flanks, and crissum streaked with burnt umber and clove brown.

* Recorded by Dr. Fisher (North American Fauna No. 7, 1893, p. 100) as *Melospiza fasciata heermanni*.

Measurements of type.—Wing, 66; tail 66; exposed culmen, 12.2; tarsus, 22.7 mm.

Geographical distribution.—Eastern California, south to Owen Valley; western Nevada; and central southern Oregon.

This new race differs from *Melospiza melodia fallax* Baird (= *Melospiza melodia montana* Henshaw) in its darker upper parts, more blackish brown streaks of under surface, heavier bill, and shorter wing.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

—S—
DESCRIPTIONS OF THREE NEW BIRDS FROM CANADA.

BY J. H. RILEY.

[Published by permission of the Secretary of the Smithsonian Institution.]

While working up the collection of birds taken on the 1911 Alpine Club of Canada's expedition to Jasper Park, Yellowhead Pass, and the Mount Robson region, the following birds have been found to be apparently unnamed and are herewith described.

***Lagopus lagopus ungavus* subsp. nov.**

Type, U. S. National Museum, No. 101,068, adult male, Ft. Chimo, Ungava, July 22, 1884. Collected by L. M. Turner (original No. 5823).

Like *Lagopus lagopus albus*, but with a heavier bill. Measurement of type: Wing, 205; tail, 128; culmen, 21.5; depth of bill at base, 15.

Remarks.—Leaving out of consideration *Lagopus lagopus alexandræ*, which is recognized as a perfectly distinct form, I have gone over the same ground as Mr. A. H. Clark,* with some additional material, and reached the following conclusions: That the name *Lagopus lagopus lagopus* should be restricted to the small-billed European bird and that the bird from the west side of Hudson Bay should be known as *Lagopus lagopus albus*.† Specimens from the mountains of western Alberta and eastern British Columbia are slightly smaller than birds from Hudson Bay and northern Alaska. There appear to be no color differences except in *Lagopus lagopus alexandræ*, which is darker. In my opinion, the willow ptarmigans of the North American mainland can be separated into at least three recognizable races, as follows:

1. *Lagopus lagopus alexandræ* Grinnell, from the southwest coast of Alaska.

2. *Lagopus lagopus albus* Gmelin, from the west side of Hudson Bay, west through northern Alaska to eastern Siberia.

3. *Lagopus lagopus ungavus* subsp. nov., from Ungava and probably the eastern shore of Hudson Bay south.

* Proc. U. S. Nat. Mus., 38, No. 1727, April 30, 1910, 51.

† [*Tetrao*] *albus* Gmelin, Sys. Nat., I, pt. 2, 750.

The average measurements of a series of willow ptarmigans taken in the breeding season, except *Lagopus lagopus alexandræ*, from the various parts of its range are as follows:

	Wing	Tail	Culmen	Depth of Bill
One male, Norway	177	97.5	17	11
Ten males, Ungava	197	121.9	20.9	13.5
Five males, west side Hudson Bay	200.6	126.7	19.1	11.8
Eight males, mountains Alberta and B. C.	188.9	118.8	18.5	12.2
Six males, northern Alaska	196.8	119.9	18.9	12.8
One male, Lake Iliamna, Alaska	195.5	111	18.5	12
One male, Petropaulski, Kamchatka	204	125.5	20	
Ten females, Ungava	179	110	19.3	12.9
Three females, west side Hudson Bay	191.2	116.7	18.3	10.8
Seven females, mts. Alberta and B. C.	174.6	96.8	16.5	11.1

***Melospiza melodia inexpectata* subsp. nov.**

Type, U. S. National Museum, No. 222,829, adult female, three miles east of Moose Lake, British Columbia, August 21, 1911. Collected by J. H. Riley (original number 2268).

Similar to *Melospiza melodia rufina*, but the browns of the upper parts lacking the reddish tinge, thus giving to the back a gray cast; below not so heavily streaked; averaging smaller. Measurement of type: Wing, 65; tail, 63.5; culmen, 12; tarsus, 22; middle toe, 15.5.

Remarks.—This race is founded on four specimens, as follows: the type and a young male still in the juvenile plumage from the type locality; one adult female from Henry House, Alberta, September 14, 1911; and an adult female from near Telegraph Creek (25 miles east, near Buckley Lake), British Columbia, July 26, 1910, the latter specimen taken by E. A. Preble and in the Biological Survey Collection. Average of the three adult females: Wing, 63.8; tail, 60.3; culmen, 12; tarsus, 21.3; middle toe, 15.7. Average of three adult females of *Melospiza melodia rufina* from the Sitkan District taken at about the same season of the year: Wing, 67; tail, 63.8; culmen, 12.8; tarsus, 22.8; middle toe, 16.

One of the interesting results of our trip was the discovery of this song sparrow, which instead of resembling *Melospiza melodia merrilli*, as one would naturally suppose, is more nearly related to the Pacific Coast bird. Its range is probably the interior mountain valleys from northern British Columbia at least, south to Henry House, Alberta, and in migration probably further. The bird taken at Henry House may have been a migrant, but the type was probably a breeding bird as the young male taken at the same locality seems to indicate.

***Passerella iliaca altivagans* subsp. nov.**

Type, U. S. National Museum, No. 222,832, nearly adult male, Moose Branch of the Smoky River, Alberta (about 7000 feet altitude), July 31, 1911. Collected by J. H. Riley (original number, 2175).

Similar to *Passerella iliaca schistacea*, but middle of the back mars brown instead of mouse gray; wings and tail with more red in the brown (near burnt umber). Measurement of type: Wing, 81.5; tail, 76; culmen, 11.5; tarsus, 21; middle toe, 14.5.

Remarks.—This race is founded on two slightly immature birds from the type locality; an immature male from Moose Pass, British Columbia; and an immature specimen from Thudade Lake (source of Finlay River), British Columbia. An adult male from Columbia Falls, Montana, September 24, 1896; an adult male and female, Ft. Klamath, Oregon, April 9 and 28, 1883; and an adult female, Ft. Crook, California, April 12, 1860, all in the collection of the U. S. National Museum, are apparently migrants of this form. They differ from the type in having the upper parts more rusty, but from typical *Passerella iliaca schistacea*, to which they have been referred, they are quite distinct, having the mouse gray of the upper parts of that race replaced by broccoli brown and burnt umber and the spotting of the under parts prout's brown, not sepia. Apparently there is no difference in size.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

SA

A NEW TEAL FROM THE ANDAMAN ISLANDS.

BY J. H. FLEMING.

While cataloguing a number of birds from the Andaman Islands, collected in 1905, by Mr. B. B. Osmaston, and now in my collection, I noticed that in a series of twelve Andaman Teal, only five agreed with the description and plate of *Nettion albigulare* (= *Polionetta albigularis*) in Vol. 27 of the Catalogue of Birds. Six from North Reef Island (to the westward of North Andaman), and one from Middle Andaman differ sufficiently from the five from South Andaman to be described as a new subspecies, which may be known as—

***Polionetta albigularis leucopareus* subsp. nov.**

Cotypes from North Reef Island, Andaman Islands, ♂ and ♀, collected by B. B. Osmaston, December 25, 1905. Fleming Coll. Nos. 19,064 (♂), and 19,069 (♀).

Characters.—Similar to *P. albigularis albigularis* (Hume), but averaging larger, with a great deal of white on head and neck; margins of body feathers cinnamon brown and better defined, producing strongly defined spots, especially on the sides of the breast.

♂. Pileum, except frontal apex, very dark brown, this color descending the sides of the face behind the auricular region, and partially surrounding it below; sides of upper neck light brown. Frontal apex and whole face, including eyebrows and auricular region, pure white, this color extending over the throat and lower neck, and continuing in a wide collar around the hind neck.

♀. Entire pileum dark brown becoming lighter on the sides of the head and neck, confining the white collar to the hind neck, and reaching forward below the auricular region. Auricular region, eyebrows, front of face, throat and lower neck as in the male.

TABLE OF MEASUREMENTS.
(Measurements in inches.)

Flem- ing Col. No.	Sex.	Date.		Wing.	Tail.	Tarsus.	Culmen.
			<i>Polionetta albigularis leucopareus.</i>				
19,065	male ad.	Dec. 25, 1905	North Reef Island, Andamans	8.20	3.23	1.45	1.35
*19,064	" "	" " "	" " " "	8.00	3.16	1.42	1.48
19,066	" "	" " "	" " " "	8.00	3.12	1.40	1.43
19,067	" "	" " "	" " " "	7.42	3.03	1.45	1.49
19,068	" "	" " "	" " " "	7.78	2.83	1.34	1.42
*19,069	female "	" " "	" " " "	7.91	2.88	1.40	1.50
19,075	(male) "	Jan. — "	North Andaman.	7.80	2.78	1.40	1.52
			<i>Polionetta albigularis albigularis.</i>				
19,073	male ad.	Dec. 10, 1905	Port Blair, South Andaman	7.60	2.80	1.32	1.47
19,071	" "	" " "	" " " "	7.58	2.88	1.37	1.37
19,072	female "	" " "	" " " "	7.70	2.57	1.40	1.37
19,070	" "	" " "	" " " "	7.48	2.61	1.31	1.35
19,074	" juv.	Oct. 10 "	Andamans	7.20	2.83	1.25	1.25

* Types.

† All primaries in quill.

‡ First primary in quill.

Remarks.—I am indebted to Dr. L. B. Bishop, of New Haven, Conn., and Mr. W. R. Ogilvie-Grant for comparing two of my North Reef Island birds (the types) with the series of Andaman Teal in the British Museum and the types of *P. albigularis*, and both gentlemen agree that my form is at least a good sub-species. I have some hesitation in including the single bird from North Andaman in the new form; it is intermediate in coloring and is probably the connecting link between the forms.

The white on the frontal apex varies, being reduced to a line in that of the Reef Island birds, and one (19,065) has a great deal of white on the crown, 19,066 has a little, and 19,064 a small spot.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

- T -

DESCRIPTION OF A NEW SUBSPECIES OF THE
PAINTED BUNTING FROM THE INTERIOR
OF TEXAS.

BY EDGAR A. MEARNs.

The Nonpareil, or Painted Bunting, of western Texas proves to be an undescribed race which may be named—

Passerina ciris pallidior subsp. nov.

PALE PAINTED BUNTING.

Type-specimen.—Adult male. Cat. No. 163673, U. S. N. M. Collected at Fort Clark, Kinney County, Texas, May 7, 1898, by Edgar A. Mearns. Original number, 11800.

Characters.—Larger than *Passerina ciris ciris*; adult male with under parts considerably paler vermilion red; rump and upper tail-coverts paler, more purplish red. Female paler throughout, with upper parts paler, grayer, less yellowish green, and under parts buffy instead of decidedly yellow.

Measurements of type (taken from the fresh specimen by the author).—Length, 155 mm.; alar expanse, 240; wing, 75; tail, 61; culmen (chord), 11.2; tarsus, 18.3; middle toe with claw, 18.3.

Geographical range.—Breeds in the interior of Texas, migrating to Arizona, Mazatlan, and the plains of Colima.

Remarks.—Topotypes of *Passerina ciris ciris* from Vera Cruz, eastern Mexico, are indistinguishable from specimens from the southeastern United States, and are probably migrants from the latter region. The breeding range of typical *ciris* extends westward from the South Atlantic States around the Gulf coast to Mexico.

A table of comparative measurements appears on following page.

TABLE OF COMPARATIVE MEASUREMENTS.

Nat. Mus. Number.	Original Number.	Locality.	Sex and age.	Date.	Wing.	Tail.	Culmen from base.	Tarsus.	Collector.
<i>Passerina ciris pallidior.</i>									
221697	83	Fort Clark, Kinney County, Texas	♂ ad.	May 5, 1898	72	57	11.2	19.5	Louis di Z. Mearns
153465	708	Albany, Texas	♂ ad.	April 29, 1889	74	59	11	19.5	E. M. Hasbrouck
134563	9194	Fort Clark, Kinney County, Texas	♂ ad.	May 15, 1893	72	61	11	19	E. A. Mearns
163670	11798	do	♂ ad.	April 28, 1898	73	61	11.4	19.7	do
163671	11799	do	♂ ad.	May 5, 1898	73	60	11.7	19.5	do
163673	11800	do	♂ ad.	May 7, 1898	75	61	11.2	19.5	do
163675	11805	do	♂ ad.	do	72	58	11.2	19.2	do
163672	11806	do	♂ ad.	do	72	59	11	20	do
163674	11807	do	♂ ad.	do	73	60	11.1	19	do
163677	11819	do	♂ ad.	do	74	62	11.2	19.6	do
<i>Passerina ciris ciris.</i>									
221944	—	Christchurch Parish, Charleston Co., S. C.	♂ ad.	May 11, 1911	69	54	10.6	18.6	E. J. Brown
222152	19126	do	♂ ad.	April 28, 1911	67	54	10.8	18.7	E. A. Mearns
222154	19206	do	♂ ad.	May 10, 1911	69	56	10.2	18.8	do
222357	1883	do	♂ ad.	May 6, 1911	68	57	9	17	J. H. Riley
222358	1884	do	♂ ad.	May 8, 1911	69	56	10	18	do
188275	—	Charleston, South Carolina	♂ ad.	June 8, 1902	67	56	10.2	18	William Palmer
222153	19151	Christchurch Parish, Charleston Co., S. C.	♂ ad.	May 2, 1811	67	57	10	18.5	E. A. Mearns
2411	—	Savannah, Georgia	♂ ad.	—	68	55	10	18	S. F. Baird
83770	—	St. Mary's, Georgia	♂ ad.	—	68	52	10.8	18	William Brewster
133089	156	Matanzas Inlet, Florida	♂ ad.	April 28, 1877	69	57	10.9	18	Wirt Robinson

Passerina ciris pallidior.—Average of ten breeding males from western Texas : wing, 73; tail, 59.8; culmen from base, 11.2; tarsus, 19.5.

Passerina ciris ciris.—Average of ten breeding males from South Carolina, Georgia, and Florida : wing, 68.1; tail, 55.4; culmen from base, 10.25; tarsus, 18.16.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

21.

A NEW SWIFT FROM PALESTINE.

BY OUTRAM BANGS.

The well-known Selah Merrill collection of birds from Palestine was acquired by the Museum of Comparative Zoölogy in July, 1909. In the species and subspecies of the region, except for a few very rare or local forms, it is complete, and most of the species are represented in long series. Though many skins are from other places, and a number were got for him by Arabs, the collection was principally made in the vicinity of Jerusalem during the years 1884-1886 by the late Rev. Dr. Merrill himself.

Some day I hope to publish a catalogue of it, with such notes as were kept by Dr. Merrill in his register, though these in many cases, I am sorry to say, are not entirely satisfactory.

The forms that have long been recognized as peculiar to Palestine and the ones recently described by Hartert during the progress of his "Vögel der Paläarktischen Fauna," appear to be all represented in the Merrill collection.

In the collection the swifts are represented by smaller series than usual, there being three skins of *Apus apus apus* (Linn.), three of *Apus affinis galilejensis* (Autin.), and two of the white-bellied swift. The latter are so very pallid and otherwise different from European specimens that I propose for the Palestine form the name,

***Apus melba petrensis* subsp. nov.**

Type from the Jordan Valley, Palestine, no. 59,534, Coll. Mus. Comp. Zool. From the Selah Merrill Coll., taken in April, 1886, original no. "a. 108."

Characters.—Similar to true *A. melba* (Linn.) of Europe, but much

paler above and the parts pale drab, lighter still on forehead and crown, the dusky marking in front of eye consequently very conspicuous; brown band across chest very narrow and the white throat patch large.

Measurements.—

No.	Wing.	Tail.	Tarsus.	Culmen.
59,534 Type	215	87	15.5	9
59,535 Topotype	219	87.5	16	9

Remarks.—Our two specimens, neither of which bears any sex mark, were in fully adult plumage, fresh and unworn, and their pallid coloring is not the result of fading.

Hartert, in Catalogue of Birds in the British Museum, Vol. XVI, p. 439, mentions some very pallid skins from the western Himalayas, and from Belgaum, and possibly the pale form described above has a wide breeding range.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW BLUE GROSBEAK FROM CALIFORNIA.

BY JOSEPH GRINNELL.

Early in 1910 an expedition was sent by the Museum of Vertebrate Zoology of the University of California to the lower Colorado valley, in California and Arizona. While working up the extensive collection of birds obtained, my attention was arrested by the appearance of the blue grosbeaks from that region. Their bills are uniformly very much larger than those of the form previously familiar to me and occurring in summer on the Pacific slope of southern and central California. Examination of specimens and literature shows that the large-billed form is the one already designated and that it is the bird of western California that needs to be named.

***Guiraca caerulea salicarius* subsp. nov.**

CALIFORNIA BLUE GROSBEAK.

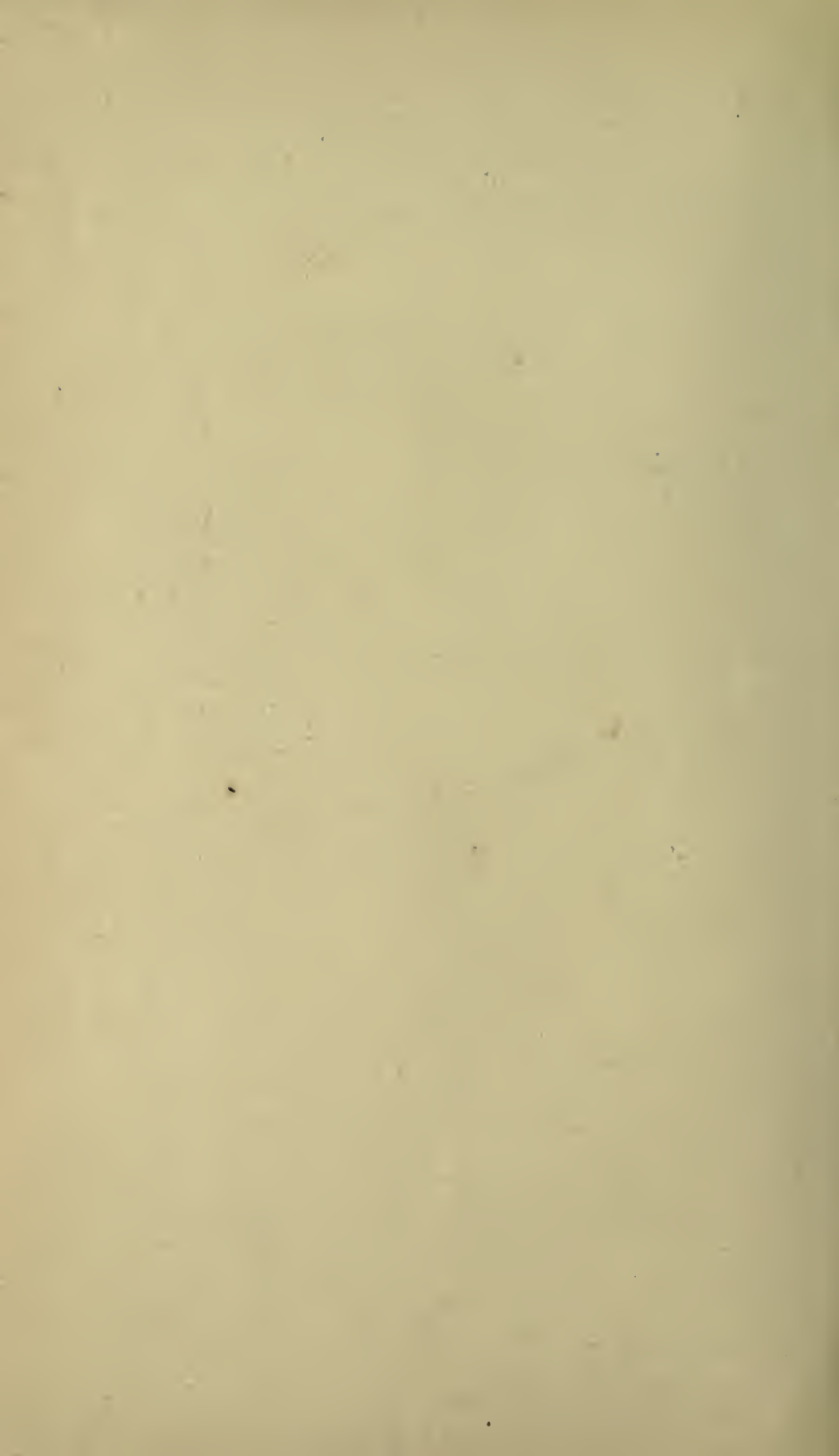
Type.—No. 3276, Univ. Calif. Mus. Vert. Zool.; Santa Ana River bottom, near Colton, San Bernardino Co., Calif.; July 21, 1908; C. H. Richardson, Jr., collector.

Diagnostic characters.—Similar to *Guiraca caerulea lazula*, of Arizona and Mexico, in coloration and general size, but bill much smaller and proportionally less tumid, that is, outlines straighter; compared with *Guiraca caerulea caerulea* of the South Atlantic States, blue color of the male paler throughout, bill smaller, and wing and tail longer.

Measurements of type.—Wing, 90.7 mm.; tail, 72.6; tarsus, 20.0; culmen, 15.0; bill-from-nostril, 11.4; depth of bill at base, 11.9; gonys, 9.5; greatest outside width of corneous portion of lower mandible, 10.4.

Habitat.—In summer, the Lower Sonoran zone of central and southern California west of the Sierran divide; in winter, unknown.

Remarks.—This form was characterized, but not named, by Ridgway (Birds N. & Mid. Am., I, 1901, p. 610). It is paralleled in many other passerine genera of the southwest, and since the characters are conspicuous to the trained eye and are fairly constant, the only wonder is that the race has not been provided with a name before.



PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

DESCRIPTIONS OF NEW AMERICAN BIRDS.

BY OUTRAM BANGS.

The American birds described as new in the following pages are from various sources, and are such as have turned up from time to time during the process of arranging and identifying the collections in the Museum of Comparative Zoology.

Rupornis magnirostris occidua subsp. nov.

Type from Rio Tambopata, eastern Peru, adult (♂?), no. 47,362, Coll. Mus. Comp. Zool. Collected by Dr. W. C. Farrabee, in May, 1907.

Characters.—Similar to true *R. magnirostris* (Gmelin) of Colombia, Guiana, and Amazonia, with the upper parts pale gray and the belly and flanks barred with white and pale cinnamon-rufous, but with the chest bright cinnamon-rufous as in *R. magnirostris natterii* (Gel. & Salv.) of Brazil, not gray as in true *R. magnirostris*.

Measurements.—Type, adult (♂?): wing, 213; tail, 143; tarsus, 63; culmen, 29.

Remarks.—The type of this new hawk was brought home, with other birds, by Dr. Farrabee, from his three years' trip to Peru and Bolivia. I tried in vain to reconcile it to either of the recognized subspecies, and upon hunting up the literature found that Hellmayr (Novit. Zool. Vol. XVII, p. 411, Dec. 1910) had already discussed similar specimens, from the same general region, arriving at the conclusion that, in all probability, they represented a third subspecies, intermediate in character between the other two.

Penelope perspicax sp. nov.

Type from San Luis, Bitaco Valley, western Colombia, adult ♀, Mus. Comp. Zool., no. 23,606, Bangs Coll. Collected June 5, 1908, by Mervyn G. Palmer.

Characters.—Somewhat like *P. cristata* (Linn.) of Central America but much smaller and with the feathers of crest, hind neck and mantle bordered by grayish white; wings, except primaries and bastard wing, metallic; bronzy brownish-like tail; primaries metallic, dark, greenish

olive (in *P. cristata* the whole wing is of this latter color). About the size of *P. boliviana* Bp. of Peru and Bolivia and with similar grayish white edging to feathers of upper parts, but with under parts as in *P. cristata* with the chestnut restricted to lower belly and under tail coverts.

Measurements.—Type, adult ♀: wing, 289; tail, 292; tarsus, 82.5; culmen, 34.5.

Remarks.—In the collections made in western Colombia by M. G. Palmer, which I got of Rosenberg, there were but two skins of this apparently very distinct species, one the type, the other a young bird just able to fly taken at Pavas, March 29, 1908.

***Antrostomus rufus otiosus* subsp. nov.**

Type from the island of St. Lucia, West Indies, adult ♂, no. 28,674, Coll. Mus. Comp. Zool. Collected by John Semper in 1878 or 1879.

Characters.—Similar to true *A. rufus* (Bodd.) of continental South America (north to Panama), but much larger, with a heavier bill.

Measurements.—

Antrostomus rufus rufus (Bodd.).

No.	Sex.	Locality.	Wing.	Tail.	Tar-sus.	Exposed Culmen.
190,352*	♀ ad.	Venez. Escorial . . .	174	116	15	9.5
6,941†	♀ ad.	Colombia, Santa Marta Mts.	176	118	16	10
14,053†	♀ ad.	Panama, near Panama . .	175	114	16.5	11

Antrostomus rufus atiosus Nob.

No.	Sex.	Locality.	Wing.	Tail.	Tar-sus.	Exposed Culmen.
80,893*	♂ ad.	West Indies, St. Lucia . .	184	130	17	14
80,894*	♀ ad.	" " "	187	122	17	13.5
27,373†	♀ ad.	" " "	185	124	16.5	14.5
32,390†	♂ ad.	" " "	187	126	18	13
27,372†	♂ ad.	" " "	186	130	17.5	13.5
28,674†	♂ ad.	" " "	187	127	17	14

Remarks.—Upon comparing a fairly good series of *A. rufus* from the mainland and from St. Lucia, the island birds were found to be so much and so constantly larger, that they can be regarded as representing a distinct subspecies.

I notice that Hartert accords to *Antrostomus rufus* an individual variation in size about corresponding to the differences between the island and the continental forms, and I suspect his larger birds were from St. Lucia and his smaller ones from the mainland.

* Coll. U. S. National Museum.

† Coll. E. A. and O. Bangs.

‡ Coll. Mus. Comp. Zool.

***Thamnophilus doliatus catus* subsp. nov.**

Cotypes from El Valle, Margarita Island, Venezuela, adults, ♂ and ♀, Mus. Comp. Zool. nos. 2712 (♂) and 2715 (♀), Bangs Coll. Collected by Austin H. Clark July 14 (♂) and July 7 (♀), 1901.

Characters.—Similar to *T. doliatus fraterculus* Berlepsch and Hartert of Venezuela and Trinidad, but somewhat smaller with somewhat smaller bill; adult ♂ with the black bands below still narrower—the under parts being white very narrowly and rather irregularly barred with black; white bands on tail as in *T. doliatus doliatus* (Linn.) of Surinam. Adult ♀ exceedingly pale, the upper parts, except pilium, ochraceous, as pale as in the Yucatan form *T. doliatus yucatanensis* Ridg., from which the female of the new form differs little except in smaller size.

Measurements.—

No.	Sex.	Locality.	Wing.	Tail.	Tarsus.	Culmen.
2711	♂ ad.	El Valle, Margarita Isl.	66	54	24	18.5
2712	♂ ad.	“ “	64	55	24.5	18
2713	♂ ad.	“ “	67	54	24.5	17
2714	♂ ad.	“ “	65	51	25.5	18
2715	♀ ad.	“ “	68	55	26	18
2716	♀ ad.	“ “	67	54	26	17

Remarks.—As *Thamnophilus doliatus* has now, by general consent, been divided into a number of subspecies, I feel little hesitation in adding another quite as good, it seems to me, as those already recognized. Individual variation in this species must, however, always be reckoned with, and series, not individuals, compared.

The pale colors of the female of the Margarita Island form have already been mentioned by Cory in his list of Birds of the Leeward Islands, based upon Ferry's series of fourteen skins, of which eight were females.

***Pyrocephalus rubineus blatteus* subsp. nov.**

Type from Sabune Dist., British Honduras, adult ♂, Mus. Comp. Zool., no. 19,812, Bangs Coll. Collected May 2, 1906, by Morton E. Peck.

Characters.—Similar to *P. rubineus mexicanus* Sel. of Mexico and the southwest border of the United States, but smaller, with an actually as well as relatively broader bill; adult male with red of under parts and pileum more crimson, less orange—about geranium red.

Measurements.—

No.	Sex.	Locality.	Wing.	Tail.	Tarsus.	Culmen.
19,812	♂ ad.	Br. Hon. Sabune Dist.	73	53.5	15.5	13
40,145	♂ ad.	Yucatan	73.5	55.	16	12.5
40,146	♂ ad.	“	74	54	16	12.5

Remarks.—This new form of the vermilion tyrant-bird occupies Yucatan, British Honduras and parts of Guatemala. The specimens which I have examined are conspicuously different from the more northern race. Its characters were fully pointed out by Ridgway in *Birds of North and Middle America*, but it was not given a name by that distinguished ornithologist.

***Leistes superciliaris petilus* subsp. nov.**

Type from Concepcion del Uruguay, adult ♂, no. 31,023, Mus. Comp. Zool. Collected November 27, 1880, by W. B. Barrows.

Characters.—Similar to true *L. superciliaris* Bp. of Brazil in color, but decidedly smaller, with a shorter bill, wing in adult ♂ about 98 (in adult ♂ of *L. superciliaris superciliaris* about 105); culmen in adult ♂ about 19.5 (in adult ♂ of *L. superciliaris superciliaris* about 22.5).

Measurements.—

No.	Sex.	Locality.	Wing.	Tail.	Tarsus.	Culmen.
31,019	♂ad.	Concepcion del Uruguay	96	57	31	19.5
31,020	♂ad.	" " "	96	58	30	19
31,021	♂ad.	" " "	97	60	29.5	19
31,022	♂ad.	" " "	98	56	30	20
31,023	♂ad.	" " "	98	57	30.5	19

Remarks.—I would also suggest the necessity of subdividing *Leistes militaris* (Linn.) and recognizing *Leistes militaris militaris* (Linn.), Guiana and eastern Peru north to Panama, smaller, with a shorter bill, wing in adult ♂ about 93, culmen about 20, and *Leistes militaris erythrorothorax* Pelzeln, Lower Amazon Valley, larger, with a longer bill, wing in adult ♂ about 100, culmen about 22.5.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NOTES ON SOME BIRDS FROM THE ISLAND OF
GRENADA.

BY T. BARBOUR.

During part of August and September of the past summer, Dr. Glover M. Allen and Mr. C. T. Brues visited Grenada for the purpose of studying the fauna. Their collections are now all in the Museum of Comparative Zoology. The ornithological collection from Grenada already in the Museum was so complete that no attempt was made to preserve series of the common birds. Special efforts to secure some of the more interesting forms were rewarded by the examples upon which these notes are based.

***Hybris* nigrescens noctividus* subsp. nov.**

Type, from St. George's, Grenada, No. 53,586, Museum of Comparative Zoology, adult male. Collected by Glover M. Allen, September 15, 1910.

Characters.—Size that of *Aluco nigrescens* (Lawrence) of Dominica, but differing as follows: tarsus somewhat longer; under parts darker in color, and much more heavily spotted with dusky; upper parts darker, and more profusely marked with larger white spots than in the owl from Dominica.

Measurements.—Wing, 230 mm.; tail, 100 mm.; tarsus, 110 mm.; culmen, 30 mm.

Remarks.—Thanks to the courtesy of Dr. Charles W. Richmond we have been enabled to compare the type of Lawrence's *A. nigrescens*, a male from Dominica (U. S. N. M. No. 77,843), as well as another from the same locality (U. S. N. M. No. 80,017), with an adult female also from this island (Bang's Coll. M. C. Z. No. 13,614). These three birds are all pale ochraceous below, somewhat mixed with whitish; while the dusky spots are confined almost wholly to the belly.

* *Hybris* is used instead of *Tyto*, which Matthews suggests (cf. Matthews, Nor. Zool., XVII, 1910, p. 500), because *Tyto*, the name for an owl, is preoccupied by *Tyta* Billberg, the name for an owlet moth. The two names have the same derivation from the Greek word *τυτώ*, meaning an owl.

Our Grenada material consists of the type already mentioned, and seven others, of which three are loaned by the United States National Museum; the Museum of Comparative Zoology having specimens from Bequia in the Grenadine Islands, as well as St. Vincent. All the birds from these southern islands of the Lesser Antillean chain are similar; and have the underparts tawny, somewhat darker than Ridgway's color on plate 5.

***Planesticus nigrirostris personus* subsp. nov.**

Type, from the Grand Etang, 2,000 feet altitude, Grenada. No. 53,598, Museum of Comparative Zoology, adult male. Collected by Glover M. Allen, September 6, 1910.

Characters.—Similar to *P. nigrirostris* (Lawrence) of St. Vincent, but differing in that the upper parts are much more darkly olivaceous, less reddish olive; the lower parts more grayish, less rufescent; and the underwing covers rather paler.

Remarks.—Mr. Ridgway, in *Birds of North and Middle America*, has already called attention to these differences. The characters being constant, as a comparison shows, these birds may be considered separate subspecies, as he suggested possible.

Among the birds credited to Grenada was one described from a single young specimen in very bad preservation, the only one ever known, and called *Blacicus flaviventris* Lawrence.

Wells, known for so many years as a collector of Grenadian birds, tried in vain to find other specimens of this extremely rare Tyrant bird. Dr. Allen was especially cautioned to watch for it, and by rare good fortune secured an adult male in the deep forest near the Grand Etang, a lake in the central part of the island at an altitude of about 2,000 feet. This specimen was the only one which he saw, in spite of a long and careful search. It was obvious at once that the bird was very different from any other *Blacicus*; and Mr. Ridgway, when he saw it, decided definitely that it was really an *Empidonax*; although there was no doubt as to the identity of this specimen with the remains of the type, now in the United States National Museum. As the specific name *flaviventris* is preoccupied, it becomes necessary to give this bird a new name. A note regarding its relationships, and a description follow.

***Empidonax johnstonei* nom. nov.**

Described from an adult male, No. 53,591, Museum of Comparative Zoology; from the Grand Etang, Grenada, B. W. I., 5 Sept., 1910, collected by Glover M. Allen.

This Tyrant bird apparently has been derived from *Empidonax lawrenci* Allen, of Trinidad, but it has become differentiated by isolation to a considerable extent. I have been enabled to make direct comparison with a fine male of *E. lawrenci* (American Museum of Natural History No. 59,067) thanks to the courtesy of Mr. Dewitt A. Miller.

Characters.—Similar to *E. lawrenci* but smaller; with a narrower bill;

color pattern very similar but the upper parts a very dark greenish olive, the cap and cheeks dusky; instead of dull olive green with the cap but little darker. Wing bars narrower and darker, being tawny ochraceous instead of ochraceous buff. Throat more purely white, underparts otherwise the same.

Measurements.—M. C. Z. No. 53,591, ♂: Wing, 60; tail, 54; tarsus, 14.5; exposed culmen, 12. A. M. N. H. No. 59,067, ♂: Princetown, Trinidad, March 16, 1893, F. M. Chapman, collector. Wing, 64; tail, 58; tarsus, 13.5; exposed culmen, 13.

The new specific name of this rare bird, which is especially interesting as being the only Antillean species of its genus, is given in honor of His Honor Robert S. Johnstone, Chief Justice of Grenada and dependencies, who has often aided the members of expeditions from this Museum by his kind hospitality and in many other ways.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

DESCRIPTION OF A NEW *DRYONASTES* FROM CHINA.

BY J. H. RILEY.

[By permission of the Secretary of the Smithsonian Institution.]

In a small lot of birds collected by Arthur de C. Sowerby in the provinces of Shansi and Shensi, China, there is a single specimen resembling *Dryonastes perspicillatus* but paler throughout and in my opinion represents a recognizable geographical race. It may be known from the following description:

***Dryonastes perspicillatus shensiensis* subsp. nov.**

Type, No. 212,067, Collection of the U. S. National Museum. Adult male. Fifteen miles south of Si-an-fu, Shensi, China, 1,500 feet altitude, February 28, 1909. Collected by Arthur de C. Sowerby.

Subspecific characters.—Similar to *Dryonastes p. perspicillatus* GMELIN of south and south-east China, but much paler both above and below and with the feathers of the throat and neck with a mere indication of a dark shaft-streak.

Description.—Forehead, supra-orbital, lores, and auriculars, black, forming a mask; crown, cervix, and occiput smoke gray, deepening into brownish on the upper back, all the feathers with very narrow edgings and indistinct shaft-streaks of hair brown; back and rump broccoli brown; upper tail-coverts isabella color; throat, jugulum, and sides of neck, smoke gray, the feathers of the throat and jugulum with hardly perceptible dusky shaft-streaks; breast, abdomen, and wing-lining, pinkish buff; thighs buff; crissum ochraceous; carpo-metacarpal bordered with clove brown; wings externally color of the back; the primaries and secondaries blackish on the inner web and then edged with buffy towards the base of the feathers; tail wood brown, all the feathers broadly tipped with black, except the middle pair, the black increasing towards the outer pair where it occupies about half the feather and extends some distance up the outer web. Wing, 134; tail, 155; culmen, 25.5; tarsus, 41.5; middle toe, 25.5 mm.

Remarks.—Besides the paler colors, *Dryonastes perspicillatus shensiensis* has the feathers of the crown and cervix less strongly edged with hair brown; the middle tail feathers are wood brown while in *D. p. perspicillatus* they are mars brown. Shensi seems to be out of the given range of *D. p. perspicillatus* and in a different faunal area.

Among the birds from the type locality of the above described race there was a single specimen of *Nannus troglodytes idius* (RICHMOND), which extends the range of this bird considerably to the west.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW FANTAIL FROM THE CHATHAM ISLANDS.

BY OUTRAM BANGS.

Several years ago the Museum of Comparative Zoology received from Mr. H. H. Travers a collection made in Snares, Auckland, Chatham and Antipodes islands. It contained one skin of a *Rhipidura* from the Chathams (probably Mangare, though the label says merely Chatham Islands) that differs in several respects from New Zealand specimens of *Rhipidura flabillifera* (Gmel.).

As this island form appears to be unnamed it may be known as—

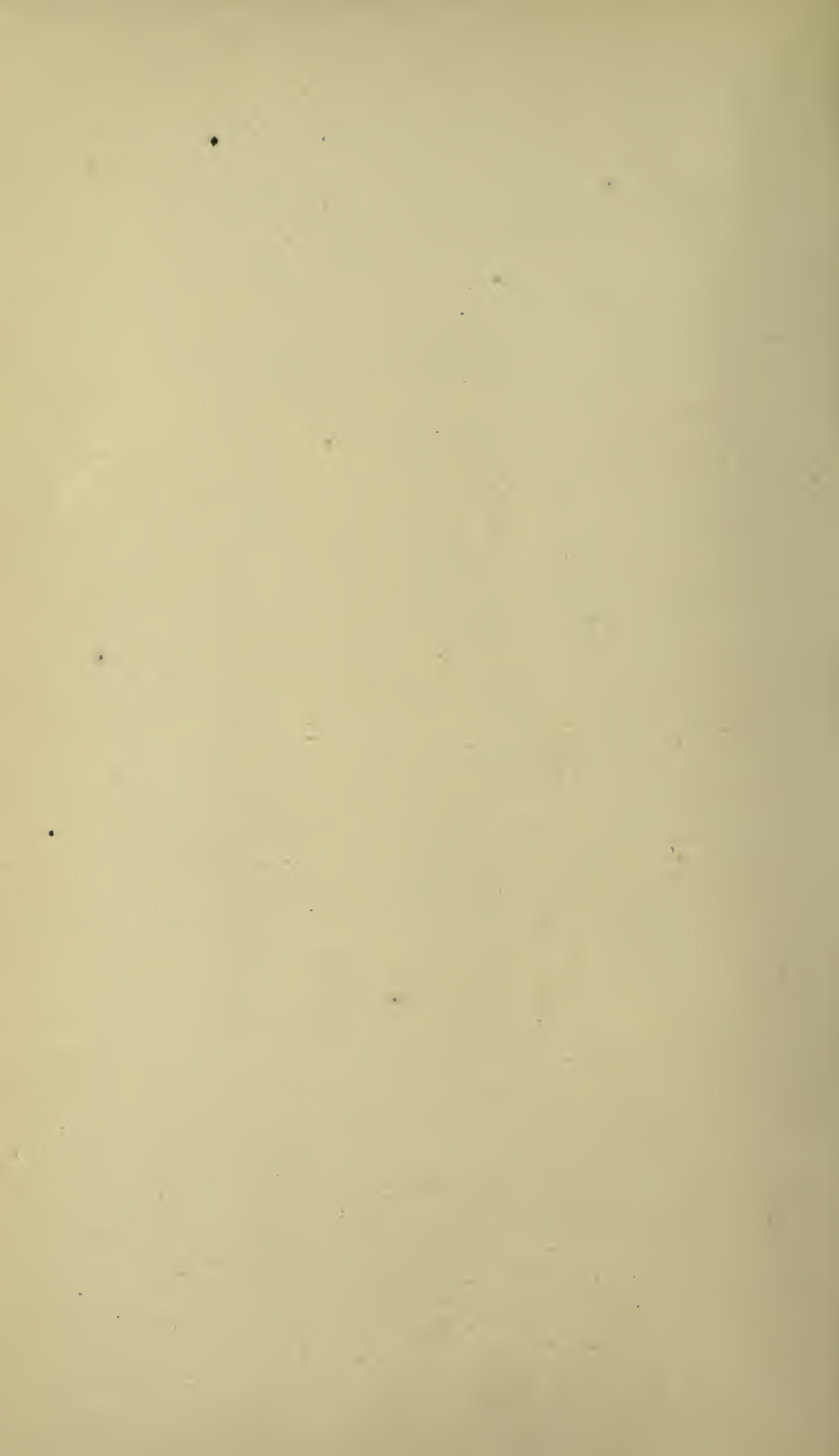
***Rhipidura flabillifera penitus* subsp. nov.**

Type from the Chatham Islands, No. 39,984, Museum of Comparative Zoology, adult ♀. Collected by H. H. Travers.*

Characters.—Similar in general to true *R. flabillifera* (Gmel.) of New Zealand, but tail longer and larger—each rectrice wider; two central rectrices grayish or hoary black instead of brownish black and with a white stripe 3 mm. wide fringing the inner web for the apical half of the feather and joining the white tip which is more extensive.

Measurements.—Type adult ♀: wing, 76; tail, 99; culmen, 8.5; tarsus, 19.5. In a series of six skins of true *R. flabillifera* from New Zealand of which only two—a male and a female—had the sex determined by the collector, the wing varies in length from 70 to 75, and the tail from 91 to 94.

* Unfortunately the skins we had of Travers had no data other than locality and sex.



PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

AA

DIAGNOSES OF SOME NEW FORMS OF PICIDÆ.

BY ROBERT RIDGWAY.

[By permission of the Secretary of the Smithsonian Institution.]

Colaptes auratus borealis subsp. nov.

Type from Nulato, lower Yukon R., Alaska. No. 49,922, U. S. Nat. Mus. Adult male. June 23, 1867. W. H. Dall.

Similar to *C. a. auratus* and *C. a. luteus* in coloration, but decidedly larger than the latter, much larger than the former. Adult male (type): Wing, 170; tail, 113; exposed culmen, 36.5; tarsus, 30; outer anterior toe, 23.

The case of *Colaptes auratus* is precisely parallel to those of *Dryobates villosus* and *D. pubescens*, all three species gradually increasing in size from the extreme southern to the extreme northern parts of their range, without material change in coloration. Evidently the three cases require identical treatment; and since three forms seem to best express the conditions in the two species of *Dryobates* (east of the Rocky Mts.) we can not have less than three forms of *Colaptes* without being conspicuously inconsistent. While *Colaptes auratus luteus* Bangs includes both the medium-sized specimens from the more northern portions of the United States and the very large ones from the far North, the type is an example of the resident bird of Massachusetts, though an exceptionally large one. Under the circumstances, it seems best to restrict the name *luteus* to the mid-region form, and give a new name to the large northern bird. By so doing, we have, as in the cases of *Dryobates villosus* and *D. pubescens*, a small Lower Austral or Austroriparian form, a medium-sized form of the Upper Austral and Transition life-zones, and a large form in the Canadian and Hudsonian zones.

The case of *Phlæotomus pileatus*, in its variations east of the Rocky Mountains, is nearly the same, but different in this respect: The species does not extend so far northward, and the lines separating (somewhat arbitrarily, as in the other species) the ranges of the two more southern forms are shifted farther southward; the extreme southern form, instead of inhabiting the Lower Austral zone as a whole, being restricted to middle and southern Florida.

***Colaptes chrysoides mearnsi* subsp. nov.**

Type from Quitovaquito, Arizona. No. 132,871, U. S. Nat. Mus. Adult male. February 2, 1894. Dr. Edgar A. Mearns, U. S. A.

Similar to *C. c. chrysoides* but decidedly larger and paler, with pileum more strongly cinnamomeous, black bars on back, etc., narrower, spots on outer web of primaries more conspicuous (primary coverts also sometimes spotted), gray of throat, etc., lighter, and spots on under parts usually smaller. Adult male (type): Wing, 146; tail, 96; exposed culmen, 35.5; tarsus, 27; outer anterior toe, 23.

There are apparently three easily characterized geographic forms of this species, as follows:

Colaptes chrysoides chrysoides (Malherbe). Southern Lower California.

Colaptes chrysoides brunnescens Anthony. Middle Lower California.

Colaptes chrysoides mearnsi Ridgway. Arizona, extreme southeastern California and northern Lower California, and southward to southern Sonora.

***Centurus chrysogenys flavinuchus* subsp. nov.**

Type from Acapulco, Guerrero, southwestern Mexico. No. 154,935, U. S. Nat. Mus. (Biological Survey Coll.). Adult male. January 13, 1895, Nelson and Goldman.

Similar to *C. c. chrysogenys* (Vigors)* but adult male with nape bright orange-yellow (instead of orange-red), strongly contrasted with red of crown; adult female with nape yellow, instead of orange or orange-red. Adult male (type): Wing, 124; tail, 75; exposed culmen, 26; tarsus, 21.5; outer anterior toe, 20.

***Centurus uropygialis brewsteri* subsp. nov.**

Type from Santiago, southern Lower California. No. 151,827, U. S. Nat. Mus. Adult male. November 22, 1887, M. Abbott Frazar.

Similar to *C. u. uropygialis*, of Arizona, etc., but smaller, with relatively (often absolutely) larger bill; bars on back, etc., averaging decidedly narrower, black bars on lower rump and upper tail-coverts narrower and more numerous, and white bars on lateral rectrices, as well as black ones on inner web of middle rectrices, narrower. Adult male (type): Wing, 129; tail, 79.5; exposed culmen, 30; tarsus, 23; outer anterior toe, 18.

***Chloronerpes rubiginosus trinitatis* subsp. nov.**

Type from Princetown, Trinidad. No. 59,416, Am. Mus. Nat. Hist. Adult male. March 3, 1893, Frank M. Chapman.

Smaller and more richly colored than *C. r. rubiginosus*, from the arid coast district of Venezuela, the back, etc., brighter, more tawny, olive, chest more brownish dusky with narrower bars of yellowish and more or less strongly suffused with dull orange or tawny. Adult male (type): Wing, 104 mm.; tail, 61.5; culmen, 23.5; tarsus, 20.5.

* The name *Centurus elegans* (*Picus elegans* Swainson, 1827) can not be used for this species, being preoccupied by *Picus elegans* Müller, 1776.

Centurus chrysogenys chrysogenys is confined to the State of Sinaloa and Territory of Tepic.

***Chloronerpes rubiginosus tobagensis* subsp. nov.**

Type from Tobago. No. 74,968, U. S. Nat. Mus. Adult male. May, F. A. Ober.

Similar in coloration to *C. r. trinitatis* but decidedly larger. Adult male (type): Wing, 115; tail, 66; culmen, 23.5; tarsus, 20. (Average measurements of adult males of the two forms are:—

C. r. trinitatis (5 specimens): Wing, 105.4; tail, 60.7; culmen, 22.9; tarsus, 20.

C. r. tobagensis (7 specimens): Wing, 111; tail, 65.5; culmen, 24.1; tarsus, 17.6.)

***Chloronerpes rubiginosus meridensis* subsp. nov.**

Type from near Merida, Venezuela. No. 100,734, Am. Mus. Nat. Hist. Adult male. S. Briceño Gabaldon.

In coloration nearest *C. r. uropygialis* from Costa Rica and Panama, but posterior under parts more strongly barred, and bill more slender. Adult male (type): Wing, 121 mm.; tail, 73; culmen, 22.5; tarsus, 21.

(Another adult male from Punta, near Merida, measures as follows: Wing, 123.5; tail, 74; culmen, 23; tarsus, 20.5.)

***Veniliornis kirkii darienensis* subsp. nov.**

Type from El Real, Darien, eastern Panama. No. 150,795, U. S. Nat. Mus. Adult male. September 3, 1889, Heyde and Lux.

Similar to *V. k. continentalis* Hellmayr, of Venezuela, but wing-coverts without yellowish spots or streaks, and under parts much more narrowly barred, the pale bars pale brownish buff instead of buffy white. Similar also to *V. k. cecilii* (Malherbe), of central Colombia, but back, etc., brighter, more tawny, and under parts more broadly barred with pale brownish buff (instead of dull whitish), and size slightly less. Adult male (type): Wing, 83; tail, 52; exposed culmen, 18.5; tarsus, 15.5; outer anterior toe, 11.5.

***Phlæotomus pileatus floridanus* subsp. nov.**

Type from Prevatt's Camp, 24 miles s. w. of Kissimmee, Florida. No. 152,136, U. S. Nat. Mus. Adult male. March 23, 1896, R. Ridgway.

Similar to *P. p. pileatus* but decidedly blacker (that is, the general blackish color less slaty or sooty), average size less, and bill relatively shorter and broader. Adult male (type): Wing, 223; tail, 151; exposed culmen, 45; tarsus, 33; outer anterior toe, 27.

The following geographic forms of this species seem to be susceptible of definition:

Phlæotomus pileatus pileatus (Linnæus). Lower Austral life-zone (except middle and southern Florida), and southern portion of Upper Austral life-zone.

Phlæotomus pileatus floridanus Ridgway. Peninsular Florida.

Phlæotomus pileatus abieticola Bangs. Canadian and Transition life-zones and northern portion of Upper Austral zone, east of Rocky Mts.

Phlæotomus pileatus picinus Bangs. Canadian and Transition life-zones of northwest coast, from British Columbia to the southern Sierra Nevada.

***Scapanus guatemalensis nelsoni* subsp. nov.**

Type from El Rincon, Guerrero, s. w. Mexico. No. 185,526, U. S. Nat. Mus. (Biological Survey Coll.) Adult male. May 8, 1903, Nelson and Goldman.

Similar to *S. g. guatemalensis* but decidedly smaller, black of upper parts, neck and chest less sooty (that of foreneck glossy, slightly bluish, that of chest more extended); back stripes whiter (less yellowish); lighter bars on under parts of body paler and narrower; yellow on under side of wings paler. Adult male (type): Wing, 177; tail, 96; exposed culmen, 42.5; tarsus, 32; outer anterior toe, 24.

The several geographic forms of this species (as I am able to make them out), with their respective ranges are as follows:

Scapanus guatemalensis guatemalensis (Hartlaub). States of Oaxaca, Tabasco, and Yucatan, southern Mexico to Costa Rica.

Scapanus guatemalensis regius (Reichenbach). Middle-eastern Mexico, in States of Tamaulipas, San Luis Potosi, and Vera Cruz.

Scapanus guatemalensis nelsoni Ridgway. Southwestern Mexico, in States of Sinaloa, Jalisco, Colima, and Guerrero and Territory of Tepic.

***Picumnus olivaceus panamensis* subsp. nov.**

Type from Lion Hill Station, Panama Railway, eastern Panama. No. 53,959, U. S. Nat. Mus. Adult male. J. McLeannan.

Similar to *P. o. granadensis* but smaller, coloration decidedly more brownish olive, pileum much duller black, and feathers of malar region and chin more narrowly margined with black or with these markings sometimes obsolete. Adult male (type): wing, 50; tail, 24; exposed culmen, 12; tarsus, 12.5; outer anterior toe, 10.5.

The following seem to me to be well-defined geographic forms of this species:

Picumnus olivaceus olivaceus (Lafresnaye). Central Colombia.

Picumnus olivaceus granadensis (Lafresnaye). Western Colombia.

Picumnus olivaceus panamensis Ridgway. Eastern Panama.

Picumnus olivaceus flavotinctus Ridgway. Western Panama and Southwestern Costa Rica.

Picumnus olivaceus dimotus Bangs. Caribbean slope, Nicaragua and Honduras.

***Balanosphyra* gen. nov. (*Picidæ*).**

Type.—*Picus formicivorus* Swainson.

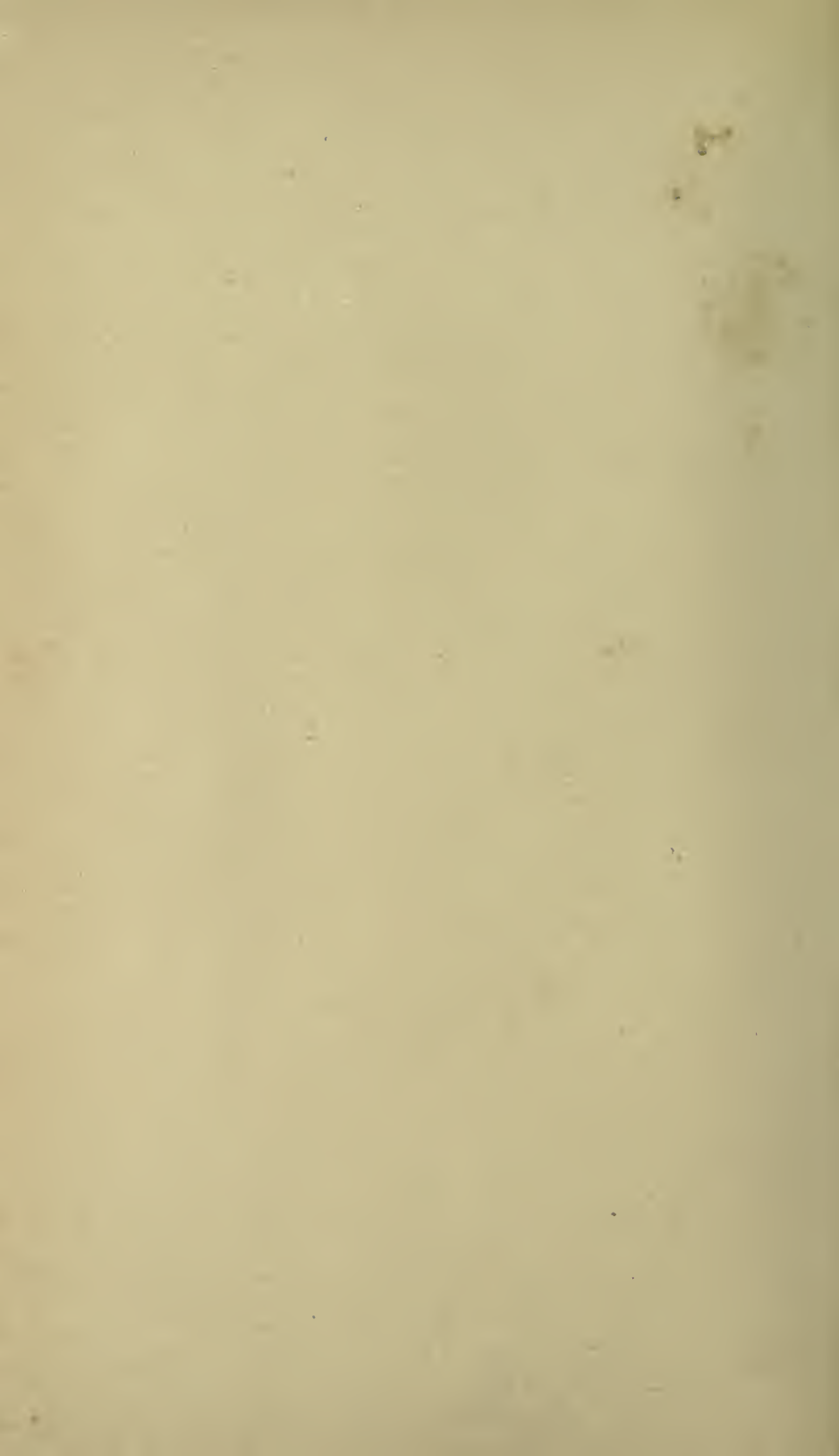
Medium sized *Picidæ* similar to *Melanerpes* but with antrorse prefrontal feathers ("nasal tufts") developed into conspicuous dense tufts; feathers of breast broad, imbricated, and firm; eighth, seventh and eighth, or sixth, seventh and eighth primaries longest; ninth primary nearly as long

as fifth, and tenth (outermost) relatively much smaller (only about one-fourth as long as ninth), narrower, and more acuminate.

(βάλανος, an acorn; σφύρα, a hammer.)

Species and subspecies:

1. *Balanosphyra formicivora*.
 - a. *Balanosphyra formicivora formicivora* (Swainson).
 - b. *Balanosphyra formicivora aculeata* (Mearns).
 - c. *Balanosphyra formicivora bairdi* (Ridgway).
 - d. *Balanosphyra formicivora angustifrons* (Baird).
 - e. *Balanosphyra formicivora albeola* (Todd).
 - f. *Balanosphyra formicivora striatipectus* (Ridgway).
2. *Balanosphyra flavigula* (Malherbe).
3. *Balanosphyra xantholarynx* (Reichenbach).



PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

BB

TWO NEW BIRDS FROM THE ISLAND OF MOLOKAI.

BY OUTRAM BANGS.

While identifying and arranging the extensive series of Hawaiian birds in the Museum of Comparative Zoology, I noticed that both the Iiwi and Ou of Molokai showed characters by which they could be picked out easily, despite the fact that ornithologists dealing with the birds of these islands have not considered them separable. I therefore propose the following names for these two subspecies:

***Vestiaria coccinea suavis* subsp. nov.**

Type from the island of Molokai, Hawaiian Islands; Museum of Comparative Zoology No. 15,059, Bangs Coll., adult ♂. Collected February 5, 1895, by M. J. Flood.

Characters.—Similar to true *V. coccinea* (Forster) of Hawaii; but larger, bill slightly stronger, and red of general plumage orange-vermilion instead of scarlet-vermilion.

Measurements.—Adult ♂, type: wing, 85; tail, 60; culmen, 28; tarsus, 25. Adult ♀, topotype, No. 15,058: wing, 80; tail, 55; culmen, 25.5; tarsus, 22.*

Remarks.—A young male of the new form, also collected by Flood, that was changing from a spotted nestling to the red dress of the adult, when compared with similar skins from Hawaii, shows exactly the same difference in the shade of the vermilion portions of its plumage as do adults. While this particular difference in the shade of vermilion is very striking in the symmetrical, smooth skins of even and regular make, which I have just compared, I must confess that it probably would not be in rough skins such as some European ornithologists appear still content with. At all events I find no mention of it in literature, although Wilson did notice certain dissimilarities in size, the shape of the bill, and in the color of the nestlings, in comparing birds from these two islands.

* In a long series of true *V. coccinea* from Hawaii, the wing in adult males averages 79.6 (78-81), in adult females, 73.75 (72-75).

The island whence the type of *V. coccinea*, brought back by Captain Cook, really came can probably never be known; it seems safe, however, to assume that it was Hawaii, as Captain Cook stopped longer there than at any of the other islands.

***Psittirostra psittacea oppidana* subsp. nov.**

Type from the island of Molokai, Hawaiian Islands; Museum of Comparative Zoology No. 15,047. Bangs Collection, adult ♂. Collected February 8, 1895, by M. J. Flood.

Characters.—Similar to true *P. psittacea* (Gmel.) of Hawaii, and quite as large; larger, therefore, than *P. psittacea deppei* Rothsch. (now supposed to be extinct) of Oahu. In color somewhat intermediate between the two. The fully adult male compared with fully adult males of true *P. psittacea* has the upper parts paler, more yellowish,—rather nearer oil-green than olive-green, instead of the reverse; the chest much paler, about gray No. 9 of Ridgway, and without darker median streaks to the feathers, instead of gray No. 6, or rarely No. 7, the feathers with darker median streaks; middle of belly with more extended grayish white patch, and sides and flanks dull olive-yellowish instead of oil-green. The adult female is more yellowish, less olivaceous green above and the sides and flanks are dull olive-yellowish, instead of oil-green.

Measurements.—Adult ♂, type: wing, 97.5; tail, 54; culmen, 16.5; tarsus, 23.5. Adult ♀, topotype, No. 15,048: wing, 93; tail, 57; culmen, 15.5; tarsus, 22.5.

Remarks.—Both Wilson and Rothschild seem to have been aware that the Molokai Ou was not quite the same as that of Hawaii, Wilson saying: "Examples from Molokai do not present any definite points of difference, though perhaps they are somewhat duller beneath"; while Rothschild specially mentions a youngish male in his collection from that island which he considered to be about intermediate between *P. psittacea* and *P. deppei*.

The three skins—two adult males and one adult female—in our collection from Molokai are all very different from any in a large series, including many adults and young of various ages from Hawaii.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

CC
A NEW BELL-BIRD FROM AUCKLAND ISLAND.

BY OUTRAM BANGS.

Among the birds the Museum of Comparative Zoology received from Mr. H. H. Travers was one skin of an adult male Bell-Bird from Auckland Island, which upon comparison proves to be so different from *Anthornis melanura* (Sparrm.) of New Zealand or *A. melanocephala* Gray of the Chatham Islands that it, as well as its two congeners, must be given specific rather than subspecific rank. Upon inquiry I found that the U. S. National Museum had one adult male from Auckland Island from the same source as ours, and this together with their entire series of *A. melanura* and *A. melanocephala* was kindly sent me by Dr. Chas. W. Richmond, acting Curator of Birds. The two specimens exactly match and are not approached by any individual variation among skins from New Zealand or the Chathams.

The new bird may be known as—

***Anthornis incoronata* sp. nov.**

Type from Auckland Island, No. 40,008, Museum of Comparative Zoology, adult ♂. Collected by H. H. Travers.

Characters.—Similar in general to *A. melanura* (Sparrm.) of New Zealand and *A. melanocephala* Gray of the Chatham Islands, and about intermediate in size—larger than the former, smaller than the latter; differing in color from both in the adult male (the female I have not seen) having the head almost without darker metallic gloss,—a faint metallic violet is just perceptible in a very narrow frontal band and slightly so on the ear coverts, the rest of the head is glossy oil-green, shining in certain lights with almost golden reflections. In the large Chatham Islands bird the whole head is dark, shining metallic-blue, in

the small New Zealand species the head is paler, a little less extensively shining and the color metallic-violet.

Measurements.—Type, adult ♂, wing, 96; tail, 90.5; tarsus, 28; exposed culmen, 15. No. 175,193, U. S. Nat. Mus., topotype, adult ♂, wing, 94; tail, 92; tarsus, 29; exposed culmen, 14.5. Averages of adult males of *A. melanura* are, wing, 88; tail, 84; tarsus, 25.5; exposed culmen, 14, while one fully adult male of *A. melanocephala* affords the following: wing, 100; tail, 96; tarsus, 34; exposed culmen, 15.5.

PRICE LIST OF PUBLICATIONS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

Vol. XXIII, 1910.

	Page	Price
Officers and Committees for 1910	iii	20
Proceedings for 1910 and Index for Vol. XXIII	vii	
Descriptions of Two New Muskrats, by N. Hollister	1-2	5
Further Notes on Fishes from the Canal Zone, by Barton Warren Evermann and Edmund Lee Goldsborough	3-6	10
A New Crinoid from the Solomon Islands, by Austin H. Clark	7-8	5
Records of Some Reptiles and Batrachians from the Southeastern United States, by C. S. Brimley	9-18	15
Brief Synopsis of the Waterrats of Europe, by Gerrit S. Miller, Jr.	19-22	10
Notes on Mammals of the Middle Mississippi Valley, with Description of a New Woodrat, by Arthur H. Howell	23-34	5
The Stridulations of Some Katydids, by H. A. Allard	35-40	10
New Genera and Species of Issidae (Fulgoridae), by E. D. Ball	41-46	15
The Scales of the Atherinid Fishes, by T. D. A. Cockerell	47-48	5
The West African Forest Pig (<i>Hylochoerus rimator</i> Thomas), by Glover M. Allen	49-52	10
Diagnoses of New Forms of Micropodidae and Trochilidae, by Robert Ridgway	53-56	10
The Generic Name of the House Rats, by Gerrit S. Miller, Jr.	57-60	10
The Scales of the Clupeid Fishes, by T. D. A. Cockerell	61-64	10
A New Bird from the Island of Ceram, Moluccas, by F. Muir and J. C. Kershaw	65-66	5
Unrecorded Specimens of Two Rare Hawaiian Birds, by Out- ram Bangs	67-70	10
New or Rare Birds from Western Colombia, by Outram Bangs	71-76	15
On the Name and Synonymy of the Antillean Sharp-shinned Hawk, by J. H. Riley	77-78	5
Two New Pocket Gophers of the Genus* <i>Thomomys</i> , by Vernon Bailey	79-80	5
Fletcher Lake, Indiana, and its Flora and Fauna, by Barton W. Evermann and H. Walton Clark	81-88	15
A New Genus of Amphibia Salientia from Dutch New Guinea, by Thomas Barbour	89-90	5
On the Nature of the Teeth in Ctenoid Scales, by T. D. A. Cockerell	91-94	10
On the Type Specimen of the Crinoid Described by Müller as <i>Alecto purpurea</i> , by Austin Hobart Clark	95-98	10
General Notes	99-100	5
A Note Regarding the Green Anolis from the Northern Baha- mas, by Thomas Barbour, 99; <i>Eleutherodactylus ricordii</i> in Florida, by Thomas Barbour, 100; On the Name of the Trinidad <i>Cœreba</i> , by J. H. Riley, 100.		
A New <i>Microsorex</i> from the Vicinity of Washington, D. C., by Edward A. Preble	101-102	5

A New Subspecies of Pigmy Owl, by E. W. Nelson	103-104	5
A New Humming Bird from the Sierra Nevada de Santa Marta, Colombia, by Outram Bangs	105-106	5
A New Tinamou from Lake Titicaca, by Outram Bangs	107-108	5
<i>Tiera longicornis</i> Lucas Referred to the Genus <i>Stenotrium</i> , by Harriet Richardson	109-110	5
On the Scales of Some Malacopterygian Fishes, by T. D. A. Cockerell	111-114	10
Description of a New Solitary Spadefoot (<i>Scaphiopus huerterii</i>) from Texas, with other Herpetological Notes, by John K. Strecker, Jr.	115-122	15
General Notes	123-124	5
Notes on Some Names of Lions, by N. Hollister, 123; The use of <i>Epimys</i> in a Generic Sense, by R. Lydekker, 124; Incuba- tion Period of Box-Turtle Eggs, by Wells W. Cooke, 124.		
A New Muskrat from the Great Plains, by N. Hollister	125-126	5
<i>Ursus sheldoni</i> , a New Bear from Montague Island, by C. Hart Merriam	127-130	10
On a Collection of Fishes from the Olympic Peninsula, together with Notes on Other West Coast Species, by Barton Warren Evermann and Homer Barker Latimer	131-140	15
The Scales of the African Cyprinid Fishes, with a Discussion of Related Asiatic and European Species, by T. D. A. Cockerell	141-152	15
Two New Woodpeckers from Central America, by W. E. Clyde Todd	153-156	10
On a Collection of Fishes from the Lower Potomac, the Entrance of Chesapeake Bay, and from Streams Flowing into these Waters, by Barton Warren Evermann and Samuel Frederick Hildebrand	157-164	15
The Amphibian Generic Name <i>Engystoma</i> Untenable, by Leon- hard Stejneger	165-168	10
A New Colubrine Snake from Java, by Thomas Barbour	169-170	5
Description of a New Genus and Species of Bivalve from the Coronado Islands, Lower California, by William H. Dall	171-172	5
Two New Woodpeckers from the Isle of Pines, West Indies, by Outram Bangs	173-174	5

• Price of the entire volume, \$3.00.

NOTE.—No single paper will be sold for less than 10 cents.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

DD

TWO NEW WOODPECKERS FROM THE ISLE OF PINES,
WEST INDIES.

OUTRAM BANGS.

When in 1905 (American Naturalist, Vol. XXXIX, No. 460, pp. 179-215) Mr. W. R. Zappey and I published an account of the birds of the Isle of Pines, based mostly upon a collection made there the previous year by him, we were aware that the red-bellied woodpecker of the island was not quite the same as that of Cuba; but on account of lack of material for comparison, we did not note any differences in the green woodpecker.

Since then the bringing together of large series of skins has shown that both the woodpeckers of the island are well differentiated subspecies; and Mr. Ridgway has urged me to describe them in time to appear in the forthcoming part of his great work, generously refusing to do so himself.

They may be known by the following short diagnoses:

Centurus superciliaris murceus subsp. nov.

Type from San Juan, Isle of Pines (near Cuba), adult ♂, No. 13,260. Bangs coll. Now in Museum of Comparative Zoölogy. Collected May 2, 1904, by W. R. Zappey.

Characters.—Similar to *C. superciliaris superciliaris* (Temm.) of Cuba, but decidedly smaller; under parts much paler and decidedly less yellowish.

Measurements.—Type, adult ♂. Wing, 138; tail, 94.5; tarsus, 23; culmen, 36. Adult ♀, No. 13,263. Wing, 139.5; tail, 99; tarsus, 24; culmen, 35.

Xiphidiopicus percussus insulæ-pinorum subsp. nov.

Type from Santa Fe, Isle of Pines (near Cuba), adult ♂, No. 13,480, Bangs coll. Now in Museum of Comparative Zoölogy. Collected April 18, 1904, by W. R. Zappey.

Characters.—Similar to *X. percussus percussus* (Temm.) of Cuba, but smaller; coloration paler, especially below; under parts more narrowly and less distinctly streaked, the streaks less blackish, more grayish; red of foreneck more restricted; auricular stripe lighter gray and rather narrower.

Measurements.—Type, adult ♂. Wing, 105; tail, 78.5; tarsus, 22; culmen, 23.5. Adult ♀, No. 13,479. Wing, 106; tail, 84.5; tarsus, 20.5; culmen, 21.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

EE

ON THE NAME AND SYNONYMY OF THE ANTIL-
LEAN SHARP-SHINNED HAWK.

BY J. H. RILEY.

[By permission of the Secretary of the Smithsonian Institution.]

In 1827, Vigors described a small sharp-shinned hawk taken near Havana, Cuba, by MacLeay, as *Accipiter fringilloides*, under which name it has always appeared in print, but if Haitian and Cuban birds are the same, as they have been considered by those who have had an opportunity of handling specimens from the two islands, then *Accipiter striatus* of Vieillot has twenty years priority and must be adopted until the birds of the two islands are proved distinct.

I am not aware that any direct comparison has been made between birds of the two islands; in fact the rarity of specimens in collections would preclude this. Lawrence, in 1860, described the adult male, adult female, young male, and two young females from Cuban specimens and Cherrie has described the adult female, adult male, and young male from Haitian specimens. Judging from descriptions, the birds of the two islands are similar or identical. I would like to add, however, that in the only specimen of the adult male handled by me the feathers of the nape have concealed white bases and the inner webs of the flight feathers externally, except the tertials, have dark cross bars, a feature not mentioned by either Lawrence or Cherrie. The following synonymy has been worked out by me and may prove useful to future investigators:

Accipiter striatus VIEILLOT, Ois. Am. Sept. I, 1807, 42, pl. 14 (Santo Domingo).—STRICKLAND, Orn. Syn., 1855, 109 (part).

Falco Viellotinus SHAW, Gen. Zool. VII, part 1, 1809, 204 (Santo Domingo).

Sparvius striatus VIEILLOT, Nouv. Dict. d'Hist. Nat. X, 1817, 325.

S[parvius] striatus VIEILLOT, Tab. Enc. Meth., III, 1823, 1265.

Accipiter fringilloides VIGORS, Zool. Journ. III, 1827, 434 (near Havana, Cuba).—DENNY, P. Z. S. Lond., 1847, 38.—LAWRENCE, Ann. New York Lyc. Nat. Hist., VII, 1860, 255 (Cuba; desc. plumages).—GUNDLACH, J. f. O., 1871, 368 (Cuba); Contr. Orn. Cubana, 1876, 44; Orn. Cubana, 1895, 25 (habits, plumages).—SHARPE, Cat. Bds. Brit. Mus., I, 1874, 135 (foot-note).—CORY, Bds. Haiti and St. Domingo, 1885, 120 (desc. and plate ♀ juv.); Auk, IV, 1887, 41 (desc.; syn.; crit.); Bds. W. I., 1889, 199; Cat. Bds. W. I., 1892, 98.

Nisus fringilloides D'ORBIGNY, La Sagra's Hist. Fis. Pol. Nat. Cuba, Aves, 1839, 31; French ed., p. 18.—RIDGWAY, Bull. U. S. Geol. and Geog. Surv. Terr. II, 1876, 117 (desc. plumages and syn.).

A[stur] fringilloides LEMBEYE, Aves de Cuba, 1850, 128.

A[stur] fuscus LEMBEYE, Aves de Cuba, 1850, 128.

Nisus fuscus CABANIS, J. f. O., II, Suppl. 1855, p. lxxxiii (Cuba).—CORY, Bull. NUTTALL Orn. Club, VI, 1881, 154 (Haiti).

Accipiter fuscus BREWER, Proc. Boston Soc. Nat. Hist., VII, 1860, 306 (Cuba).

[*Accipiter*] *fringilloides* BREWER, Proc. Boston Soc. Nat. Hist., VII, 1860, 306 (Cuba).—GUNDLACH, J. f. O., 1861, 322 (Cuba); J. f. O., 1862, 188; Repertorio fis.-nat. Cuba, I, 1865-66, 224.—GRAY, Handl. Bds. I, 1869, 32 (Cuba).—SCLATER and SALVIN, Nom. Avium Neotr. 1873, 120 (Cuba).—CORY, List Bds. W. I. 1885, 22.—GURNEY, List Diurnal Bds. Prey, 1884, 42.—SHARPE, Handl. Bds., I, 1889, 252.

Acc[ipiter] fringilloides GUNDLACH, Anales Hist. Nat. Madrid, II, 1873, 100 (Cuba).

N[isus] fuscus var. *fringilloides* BAIRD, BREWER and RIDGWAY, Hist. N. Am. Bds., III, 1874, 223.

N[isus] fringilloides RIDGWAY, Bull. U. S. Geol. and Geog. Surv. Terr. II, 1876, 95 (Cuba).

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

FF

NEW OR RARE BIRDS FROM WESTERN COLOMBIA.

BY OUTRAM BANGS.

The birds mentioned below were contained in a second collection* from western Colombia made by Mervyn G. Palmer, which I received from Mr. W. F. H. Rosenberg last summer but only just now have had time to touch. The region Mr. Palmer has been working in is a very rich one, and both collections sent me by Mr. Rosenberg have fairly astonished me in the numbers of rare and new forms they contained.

Following are short descriptions of the new forms in the present collection, and mention of a few other species where ranges are extended or the record is apparently worth publishing.

***Botaurus pinnatus* (Wagler).**

Two specimens, ♂ and ♀, taken at Guabinas, Rio Cauca, January 10, 1908. This bittern seems to be very rare in South America north of Guiana, though it has been taken in Nicaragua.

***Odontophorus baliolus* sp. nov.**

Type from Naranjito, Rio Dagua, western Colombia. Adult ♀, No. 23,432, Bangs collection, Museum of Comparative Zoology. Collected June 20, 1908, by M. G. Palmer.

Characters.—Somewhat similar to *O. parambæ* Rothschild of western Ecuador, but very much darker; upper parts nearly solid blackish-brown, only very slightly peppered and marked with paler (very different from the mottled upper parts of *O. parambæ*); under parts deep chestnut, much darker than in *O. parambæ*; black of chin and upper throat bordered above by a white stripe (not present in *O. parambæ*).

Measurements.—Type, adult ♀, wing, 132; tail, 48; tarsus, 36; culmen, 18.

* In July, 1908, in these Proceedings, I published a short paper on the first lot sent me from this source by Mr. Rosenberg.

***Syrnium nigrolineatum nigrolineatum* Sclater.**

One adult ♀, La Maria, Dagua Valley, May 26, 1908. This skin is an exact match for several Chiriqui specimens, and the form thus ranges into western Colombia, while in the Bogota region *Syrnium nigrolineatum spilonotum* Sharpe takes its place.

***Picumnus canus* sp. nov.**

Type from Naranjito, Rio Dagua, western Colombia. Adult ♀, No. 23,434, Bangs collection, Museum of Comparative Zoology. Collected June 20, 1908, by M. G. Palmer.

Characters.—Similar to *P. olivaceus* Lafr. in pattern, but slightly larger and of a very different color, being whitish and gray instead of olive and greenish.

Top of head black with small white spots; rest of upper parts dull smoke gray, wings somewhat edged with yellowish-white; belly dull white, faintly striped with dusky; chest dull grayish, passing into whitish-gray on throat; sides slightly tinged with pale yellowish.

Measurements.—Type, adult ♀, wing, 56; tail, 29.5; tarsus, 12.5; culmen, 12.

***Threnetes fraseri* (Gould).**

A fine adult, sex not determined, of this Ecuadorian species was taken at Naranjito, Rio Dagua, June 22, 1908.

***Xiphorhynchus rosenbergi** sp. nov.**

Type from Guabinas, Rio Cauca, western Colombia. Adult ♂, No. 23,436, Bangs collection, Museum of Comparative Zoology. Collected January 9, 1908, by M. G. Palmer.

Characters.—Nearest to *X. chunchotambo* (Tschudi), of which it may be a subspecies, but with a *much heavier* bill; under parts paler; throat more buffy, and striping of chest heavier. From *X. nana* (Lawr.), which it somewhat resembles in general coloration, the new form can at once be told by having the middle of back distinctly marked with pale shaft lines bordered by black, by the striping of the chest being wider, the stripes more distinctly bordered by black, and by the belly being less indistinctly striped.

Measurements.—Type, adult ♂, wing, 108; tail, 97.5; tarsus, 23; culmen, 36.

***Rhopoctites alogus* sp. nov.**

Type from near Pavas, west slope of Colombia, at 4,400 feet altitude. Adult ♂, No. 23,438, Bangs collection, Museum of Comparative Zoology. Collected February 8, 1908, by M. G. Palmer.

Characters.—Somewhat similar to *R. rufibrunneus* (Lawr.) of Costa Rica and Panama, but larger; bill both longer and stouter; colors above

* Named for Mr. W. F. H. Rosenberg of London, who has taken much interest in securing collections from this region.

duller, more olivaceous, less reddish brown; throat and sides of neck ochraceous instead of orange-rufous; body below from the chest backward uniform tawny ochraceous, wholly unstreaked, darker and browner on flanks and under tail coverts; pileum and cervix with narrow, pale shaft streaks to all the feathers—very different from the solidly brown pileum of *R. rufibrunneus*.

Measurements.—Type, adult ♂, wing, 97.5; tail, 91; tarsus, 27; culmen, 25.5.

But one specimen, the type, of this very distinct species was contained in the collection sent me. It represents a species wholly unlike *Automolus ignobilis* Scl. & Salv. or any other species so far as I can find, except *R. rufibrunneus*, from which also it is strikingly different.

Myrmeciza berlepschi Ridg.

This species was represented by six specimens, adults of both sexes, from Palmar, Pavas, and La Maria, western Colombia, taken in February, March, and June, which I have compared with the type from Chimbo, Ecuador, and find to be identical with it.

Rhynchocyclus sulphureus a. *asemus* subsp. nov.

Type from near Pavas, western Colombia, 4,400 feet altitude. Adult ♂, No. 23,439, Bangs collection, Museum of Comparative Zoology. Collected February 15, 1908, by M. G. Palmer.

Characters.—Almost exactly intermediate between *Rhynchocyclus cinereiceps* of Central America and *R. sulphureus exortivus* of the Santa Marta region of Colombia; differing from the former in having the throat and chest less strongly gray, but with the cap and back identically the same; from the latter it differs in having the cap much darker and clearer gray—less mixed with olive green; the back darker olive green; and the throat and chest just a trifle grayer.

Measurements.—Type, adult ♂, wing, 70; tail, 59; tarsus, 18; culmen, 11.5.

Three skins of this form were sent in—the type, and two adult males from Jimenez, killed in May. The subspecies is one of those that has no one very good character to distinguish it, but that is exactly intermediate between two quite different birds, resembling above *R. cinereiceps* and below *R. exortivus*.

It proves conclusively to my mind that *R. cinereiceps* is nothing more than a northern subspecies of *R. sulphureus*.

Mionectes olivaceus hederaceus subsp. nov.

Type from near Pavas, western Colombia, 4,400 feet altitude. Adult ♀, No. 23,442, Bangs collection, Museum of Comparative Zoology. Collected February 12, 1908, by M. G. Palmer.

Characters.—Like *M. olivaceus venezuelensis* Ridg. in having under parts heavily streaked, but much darker, more grayish olive below; duller and darker greenish olive above, with the pileum much darker and

grayer than back, and of the size of *M. olivaceus olivaceus*, not larger. From *M. olivaceus olivaceus* it differs in much heavier, coarser streaking below, and in general darker, grayer coloration, the pileum much grayer and the back much darker, more grayish olive-green.

Measurements.—Type, adult ♀, wing, 62; tail, 47; tarsus, 15.5; culmen, 12.5.

Another specimen, from Rio Bitaco, May 2, 1908, is precisely like the type, and the west Colombian subspecies seems a very well marked one. I also received a skin of *M. striaticollis poliocephalus* Tschudi, collected by Mr. Palmer at San Antonio, Rio Cali, November 21, 1907.

***Pheugopedius spadix* sp. nov.**

Type from Naranjito, Rio Dagua, western Colombia. Adult ♂, No. 23,446, Bangs collection, Museum of Comparative Zoology. Collected June 20, 1908, by M. G. Palmer.

Characters.—A very distinct species, apparently most nearly related to *P. atrogularis* (Salvin) of Costa Rica, but at once distinguished from that species by having a banded tail.

Color.—Pileum clove brown; sides of head and throat (not extending at all onto chest or neck) black, the ear coverts, a narrow line of feathers above the eye and on sides of the front, with white shaft stripes; upper parts, including margins of wing feathers (the wings unbanded), under side of neck, chest, breast and sides, rich chestnut; flanks dull brown, about between Prout's Brown and raw umber; middle of belly and under tail coverts dull raw umber, with indistinct dusky cross bars; tail regularly barred across with black and chestnut, the black bars a little the wider.

Measurements.—Type, adult ♂, wing, 64; tail, 54; tarsus, 23; culmen, 16.5.

***Pheugopedius mystacalis saltuensis* subsp. nov.**

Type from San Luis, Bitaco Valley, western Colombia. Adult ♂, No. 23,448, Bangs collection, Museum of Comparative Zoology. Collected June 5, 1908, by M. G. Palmer.

Characters.—Similar to *P. mystacalis mystacalis* (Scl.) of Pallatanga, Ecuador, but head and hind neck much purer gray; breast, chest and sides much grayer, less buffy, being mouse gray; black malar stripe wider and consequently white supramalar stripe narrower.

Measurements.—Type, adult ♂, wing, 68; tail, 61; tarsus, 26.5; culmen, 18.5.

An adult male topotype is exactly similar, and the two skins I compared very carefully with many Ecuador specimens.

***Henicorhina leucosticta eucharis* subsp. nov.**

Type from near Pavas, western Colombia, 4,400 feet altitude. Adult ♂, No. 23,444, Bangs collection, Museum of Comparative Zoology. Collected February 18, 1908, by M. G. Palmer.

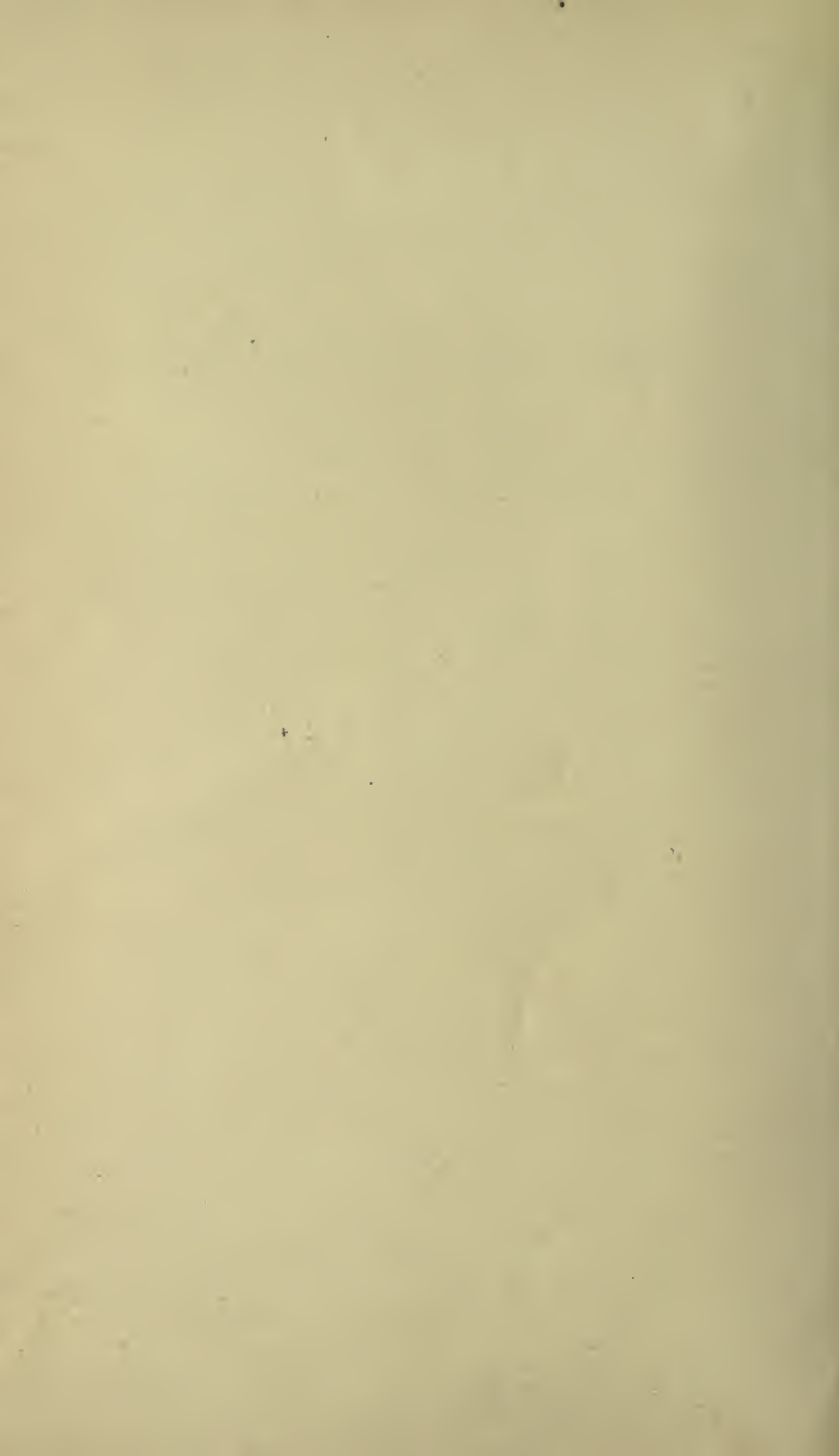
Characters.—Similar to *H. leucosticta leucosticta* (Cabanis) of Guiana, but colors of upper parts and flanks paler, duller, much less chestnut or reddish brown—in the adult ♂ of the new form the back and wings are dull russet, the rump and upper tail coverts clear, pale russet, the flanks and under tail coverts cinnamon-russet. The female is similar, but slightly duller in color and with the pileum not solidly black, but dark brown medianly.

Measurements.—Type, adult ♂, wing, 62; tail, 31.5; tarsus, 23.5; culmen, 16.5. Adult ♀, No. 23,445, from near Jimenez, western Colombia, April 16, 1907; wing, 58; tail, 30; tarsus, 22; culmen, 15.5.

***Phoenicotheraupis cristata* Lawr.**

Three adult specimens, two males and a female, were secured at Naranjito, Rio Dagua, in June and July, 1908.

This species still remains so rare in collections that I have thought it worth while to make this record.



PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

UNRECORDED SPECIMENS OF TWO RARE HAWAIIAN
BIRDS.

BY OUTRAM BANGS.

Lately while arranging the skins of *Acrulocercus nobilis* in the Museum of Comparative Zoology I discovered among them a fine example of the long ago extinct *Acrulocercus apicalis* (Gould) of Oahu Island.

This specimen came to the museum in exchange from Brown University and had formerly belonged to John Cassin. It bears a label in Cassin's hand with the inscription, "Sandwich Isld. J. K. Townsend male," and was without doubt collected by Townsend during his visit to Oahu in 1835. The skin, No. 17,598, Museum of Comparative Zoology, is that of a fine adult male and although made seventy-five years ago is in perfect preservation, except that its feet and legs have, at some time, been somewhat eaten by insects.

Wilson and Evans in their *Aves Hawaiiensis*, 1890-1899 (p. "103"—the work is not paged) mention five specimens, all that were known to them, of *A. apicalis*—three in the British Museum, one of which went by exchange to Rothschild's Tring Museum, and a pair collected by Deppe which are in Vienna.

Rothschild, *Extinct Birds* 1907, p. 27, enumerates the same five specimens, but says that Deppe's skins are in Berlin.

Ours makes the sixth known example of *A. apicalis*, which is believed to have been confined to Oahu and which has not been seen alive by a naturalist since 1837.

It is the only one in America, Dr. Chas. W. Richmond informing me that the United States National Museum does not possess any, and Mr. Witmer Stone says that there is none in

the Academy of Natural Sciences in Philadelphia, although that institution had most of Cassin's Collection of birds.

In the Museum of Comparative Zoology there is also a fine pair of *Ciridops anna* (Dole), one of the very rarest of Hawaiian birds and certainly one of the most beautiful.

The exact origin of these skins, of excellent make and in perfect preservation, I have been unable to learn. They came to the museum with a few other Hawaiian birds—six skins of *Acrulocercus nobilis* and several petrels and terns—and were catalogued by Dr. J. A. Allen in 1870; names for none but the Moheo being written on the labels or in the register by that naturalist.

Ciridops anna was described by Judge Dole in 1879 and is supposed to be, or perhaps better to have been, confined to the island of Hawaii. It was, until I unearthed our two skins, known by three male specimens only, one now in the Bishop Museum and two in Rothschild's Museum at Tring. The female and young male were unknown.

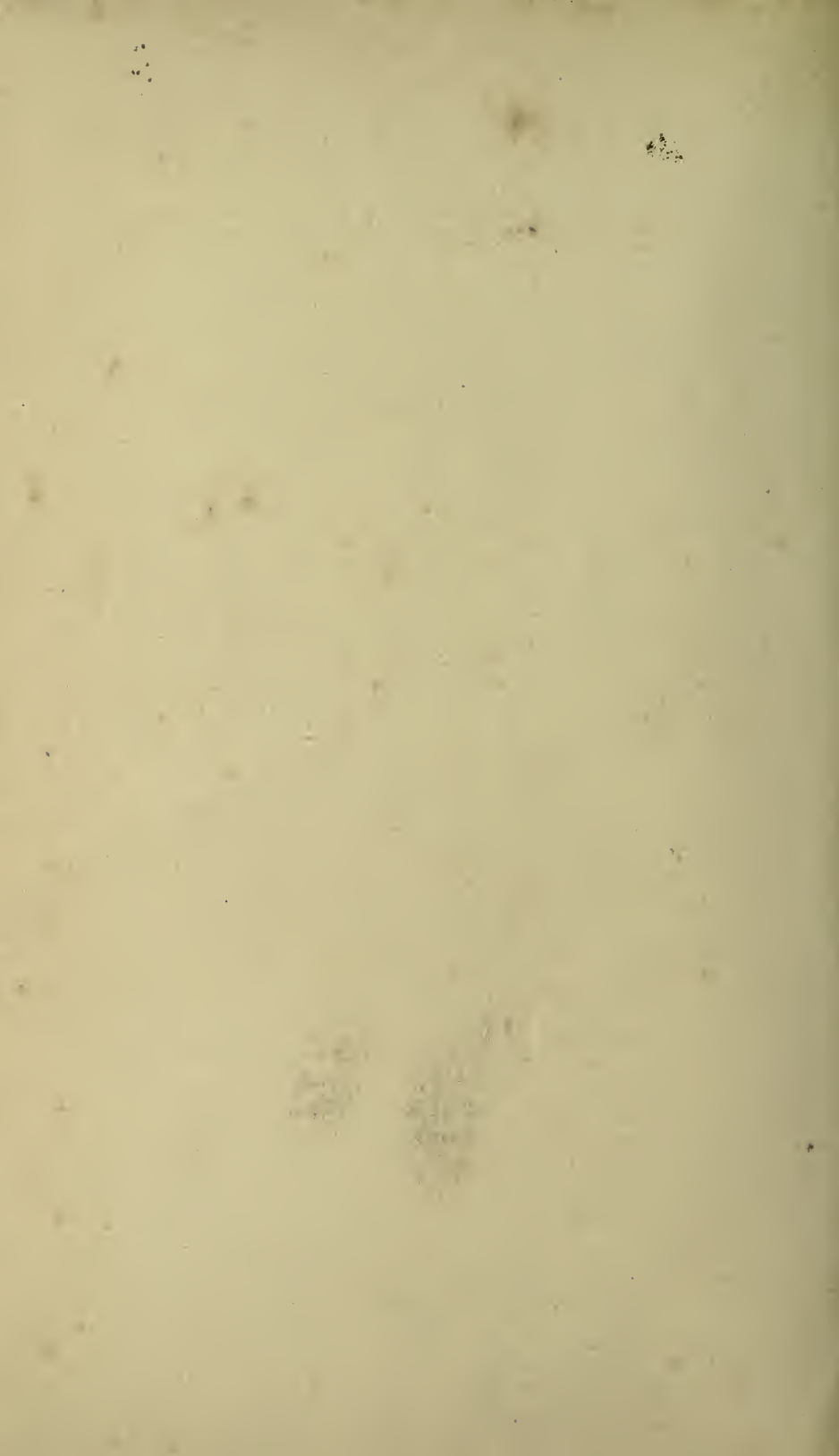
Our male, No. 10,995, is in full plumage and very closely matches the exquisite plate in Wilson and Evans, *Aves Hawaiiensis*.

Our other specimen, No. 10,987, I take to be an adult female. Though a little smaller, it is exactly similar in proportions to the male, but is wholly different in color. It may be described as follows—

Forehead clothed in stiffened, pointed, semi-erect feathers as in the adult male. Top of head, nape, and sides of head cinnamon washed with dull olive-yellow on forehead and with the lores and a narrow frontal band more dusky; cheeks with paler shaft-stripes to the feathers; lower back grayish cinnamon, gradually passing into the purer color of the head; rump and upper tail coverts olive-yellow; tail dusky, fringed with olive-yellow; primaries blackish, narrowly edged with dark olive-yellow; secondaries more broadly edged with the same, the innermost nearly wholly dark olive-yellow; throat dull cinnamon, the feathers with paler shaft stripes, slightly washed with yellow-olive in lower middle; chest and breast dingy-smoke-gray, somewhat washed with olive, gradually passing into dark olive-yellow on belly; under wing coverts, axillars, under tail coverts and a small patch in lower middle belly

dilute rufous-cinnamon. The general pattern thus resembles that of the adult male, though the colors themselves are very different. Our two skins afford the following measurements (in mm.):

<i>No.</i>	<i>Sex.</i>	<i>Wing.</i>	<i>Tail.</i>	<i>Tarsus.</i>	<i>Culmen.</i>
10995	(♂ ad.)	80	44	22	11
10987	(♀ ad.)	73.5	41	21	10



PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

44 44
A NEW BIRD FROM THE ISLAND OF CERAM,
MOLUCCAS.

BY F. MUIR AND J. C. WERSHAW.

While collecting in the Dutch East Indies a new *Pitta* was captured which may be known as

***Pitta piroensis* sp. nov.**

Type.—An adult male from Piroe, Ceram, Museum of Comparative Zoology, Cat. No. 49,997, collected by the authors, March 2, 1909.

Description.—Forehead and upper part of head and neck dark red-brown, the crown divided by an obscure median bluish stripe: a large sub-quadrangular scarlet nuchal patch. Throat dark brown, shading into black on upper part of breast. Ear coverts and lower part of breast silvery blue-gray. Back and scapulars dark olive green. Tail and upper tail coverts grayish-blue. Bend of wing nearly black, feathers lighter round edge; lesser coverts blue-gray, the feathers dark brown at base; greater coverts very dark brown, edged and tipped with dark blue-gray. Primaries nearly black, the 2d, 3d, 4th and 5th with a white speculum marking, but only the 4th and 5th have the white on the upper side of the outer web. Under wing-coverts dark bluish gray. Belly, vent and under tail-coverts scarlet. Eyes brown; bill black; legs and feet pale lead color; claws brownish; soles of feet ochreous. Total length, $6\frac{1}{2}$ in.; wing, $3\frac{5}{8}$ in.; tail, $1\frac{3}{8}$ in.; bill (to gape) 1 in.; tarsus, $1\frac{5}{8}$ in.

This species differs from *P. rubrinucha* Wallace, in its slightly smaller size, its silvery blue-gray ear-coverts, in the absence of the black line separating the silvery blue-gray of the breast from the scarlet belly, in the absence of a white shoulder-spot, and in the different marking of the white speculum spot on the primaries.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

II

A NEW BIRD FROM THE ISLAND OF CERAM,
MOLUCCAS.

BY F. MUIR AND J. C. KERSHAW.

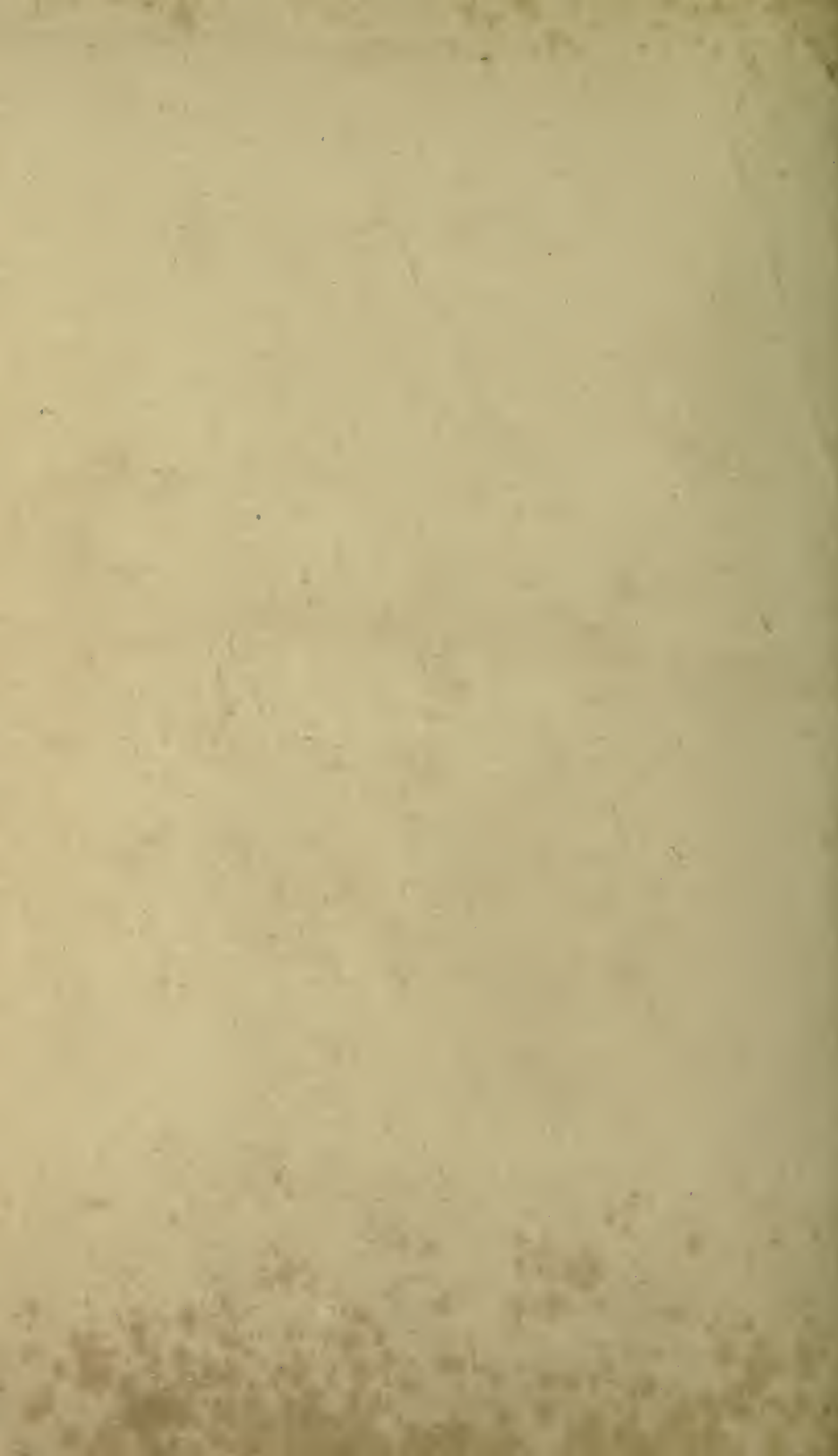
While collecting in the Dutch East Indies a new *Pitta* was captured which may be known as

***Pitta piroensis* sp. nov.**

Type.—An adult male from Piroe, Ceram, Museum of Comparative Zoology, Cat. No. 49,997, collected by the authors, March 2, 1909.

Description.—Forehead and upper part of head and neck dark red-brown, the crown divided by an obscure median bluish stripe; a large sub-quadrangular scarlet nuchal patch. Throat dark brown, shading into black on upper part of breast. Ear coverts and lower part of breast silvery blue-gray. Back and scapulars dark olive green. Tail and upper tail coverts grayish-blue. Bend of wing nearly black, feathers lighter round edge; lesser coverts blue-gray, the feathers dark brown at base; greater coverts very dark brown, edged and tipped with dark blue-gray. Primaries nearly black, the 2d, 3d, 4th and 5th with a white speculum marking, but only the 4th and 5th have the white on the upper side of the outer web. Under wing-coverts dark bluish gray. Belly, vent and under tail-coverts scarlet. Eyes brown; bill black; legs and feet pale lead color; claws brownish; soles of feet ochreous. Total length, 6½ in.; wing, 3⅝ in.; tail, 1⅜ in.; bill (to gape), 1 in.; tarsus, 1⅝ in.

This species differs from *P. rubrinucha* Wallace, in its slightly smaller size, its silvery blue-gray ear-coverts, in the absence of the black line separating the silvery blue-gray of the breast from the scarlet belly, in the absence of a white shoulder spot, and in the different marking of the white speculum spot on the primaries.



PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

DIAGNOSES OF NEW FORMS OF MICROPODIDÆ AND
TROCHILIDÆ.

BY ROBERT RIDGWAY.

[By permission of the Secretary of the Smithsonian Institution.]

***Streptoprocne zonaris mexicana* subsp. nov.**

Type from Rio Seco, near Cordova, Vera Cruz, Mexico. No. 41,636, U. S. Nat. Mus. Adult male. January, 1866, Prof. F. Sumichrast.

Similar to *S. z. albicincta* (Cabanis), of Costa Rica and northern South America, but averaging larger, general coloration decidedly duller (less bluish) black, and forehead always distinctly grayish sooty. Adult male (type): Wing, 207.5 mm.; tail, 83; exposed culmen, 10; tarsus, 22.5; middle toe, 15.

***Chætura richmondi* sp. nov.**

Type from Guayabo, eastern Costa Rica. No. 209,570, U. S. Nat. Mus. Adult female. March 5, 1908. Museum-Zeledón Exped.

Similar to *C. gaumeri*, of Yucatan, but larger and coloration darker, the pileum and back more nearly black; spiny tips to rectrices longer, always well developed. Adult female (type): Wing, 115 mm.; tail, 37.5; exposed culmen, 4.5; tarsus, 10.5; middle toe, 8.

***Cypseloides niger jamaicensis* subsp. nov.**

Type from Mayfield, St. Andrews, Jamaica. No. 78,205, U. S. Nat. Mus. Adult female. June 25, 1879, Edward Newton.

Similar to *C. n. niger*, of Santo Domingo, but much darker (especially the adult female), the upper and under parts sooty black, more or less distinctly (but not conspicuously) paler or more grayish sooty on chin, throat, and chest. Adult female (type): Wing, 149.5 mm.; tail, 64.5; exposed culmen, 5.5; tarsus, 11.5; middle toe, 9.5.

***Cypseloides niger costaricensis* subsp. nov.**

Type from San José, Costa Rica. No. 108,275, U. S. Nat. Mus. Adult male? May 10, 1885, José C. Zeledón.

Similar to *C. n. borealis*, of western North America, but smaller and decidedly darker, the adult female with feathers of abdomen and flanks

usually more broadly tipped with white; adult male similar to that of *C. n. jamaicensis*, but wing averaging longer and tail decidedly shorter, and general color of head and neck decidedly more grayish. Adult male? (type): Wing, 155 mm.; tail, 57; exposed culmen, 6; tarsus, 12; middle toe, 9.

***Phæthornis longirostris veræcrucis* subsp. nov.**

Type from Buena Vista, Vera Cruz, southeastern Mexico. No. 177,330, U. S. Nat. Mus. Adult male. May 23, 1901, A. E. Colburn.

Similar to *P. l. mexicanus* (of southwestern Mexico) in white (instead of buff) terminal margins to lateral rectrices, but much smaller, and paler in coloration. Adult male: Wing, 60–65.5 (62.9) mm.; tail, 65–70 (67.9); culmen, 39–42.5 (40.3).*

***Phæthornis adolphi saturatus* subsp. nov.**

Type from El Hogar, Costa Rica. No. 26,741, coll. Carnegie Museum. Adult male. December 19, 1905, M. A. Carriker, Jr.

Similar to *P. a. adolphi* (from southern Mexico), but adult male decidedly darker, especially chin, throat and chest, the first being distinctly dusky.

Guatemala to Panama. (Guatemalan specimens are intermediate, but seem to be more like those from Costa Rica than like those from Mexico.)

***Eupherusa eximia nelsoni* subsp. nov.**

Type from Motzorongo, Vera Cruz, Mexico. No. 155,363, U. S. Nat. Mus. (Biological Survey Coll.) Adult male. February 28, 1894, Nelson and Goldman.

Similar to *E. e. eximia*, but larger, especially the bill; green of underparts more yellowish, and black tip to lateral rectrices with line of demarcation against the basal white decidedly oblique and much less sharply defined.

Adult male.—Length, 93–103 (98) mm.; wing, 60.5–61 (60.7); tail, 34–35.5 (34.7); culmen, 18.5–19 (18.7).†

***Amizilis bangsi* sp. nov.**

Type from Volcan de Miravalles, northwestern Costa Rica. No. 16,682, coll. E. A. and O. Bangs. Adult male. September 7, 1895, C. F. Underwood.

Similar to *A. cinnamomea cinnamomea*, but whole side of neck, including lateral portions of lower throat, metallic greenish bronze or bronze-green instead of light cinnamon-rufous.

*Adult males of *P. l. mexicanus* measure as follows: Wing, 67–69.5 (68.1); tail, 83–87 (84.6); culmen, 45.5–47 (46.1).

†Two specimens. The corresponding measurements of a series of eleven adult males of *E. e. eximia* (ten from Guatemala, one from Nicaragua) are as follows: Length, 84–93 (89); wing, 56.5–61 (58.7); tail, 32.5–34.5 (33.5); culmen, 16–19 (17.6).

***Anthracothorax prevosti gracilirostris* subsp. nov.**

Type from Bolson, Costa Rica. No. 22,629, coll. E. A. and O. Bangs. Adult male. December 16, 1907, C. F. Underwood.

Differing from *A. p. prevosti* in decidedly shorter and more slender bill, less bronzy or golden green upper parts, and darker under tail-coverts; from *A. p. hendersoni* in more slender bill and very much less bronzy color of upper parts and lateral under parts.

Costa Rica and Nicaragua.

Average measurements of the three forms are as follows:

Males.

<i>A. p. prevosti</i> (24 specimens) .	66	35.6	26.2
<i>A. p. gracilirostris</i> (9 specimens) .	65.9	35.3	24.4
<i>A. p. hendersoni</i> (4 specimens) .	67	36.7	22.9

Females.

<i>A. p. prevosti</i> (15 specimens) . .	64.7	34.3	28.1
<i>A. p. gracilirostris</i> (10 specimens) .	65.2	35.4	25.4
<i>A. p. hendersoni</i> (2 specimens) .	66.2	35	22.7

***Florisuga mellivora tobagensis* subsp. nov.**

Type from Tobago. No. 74,908, U. S. Nat. Mus. Adult male. F. A. Ober.

Similar to *F. m. mellivora*, but decidedly larger.

Measurements of type.—Wing, 70.5; tail, 38.5 mm.

***Nesophlox* gen. nov. (*Trochilidæ*).**

Type.—*Trochilus evelynæ* Bourcier.

Similar to *Calliphlox* Boie, but wing relatively much larger, with outermost primary not attenuated terminally; adult males with lateral rectrices broadly edged with rufous on inner webs, and adult females with tail more than half as long as wing.

(νησος, island; φλόξ, a flame.)

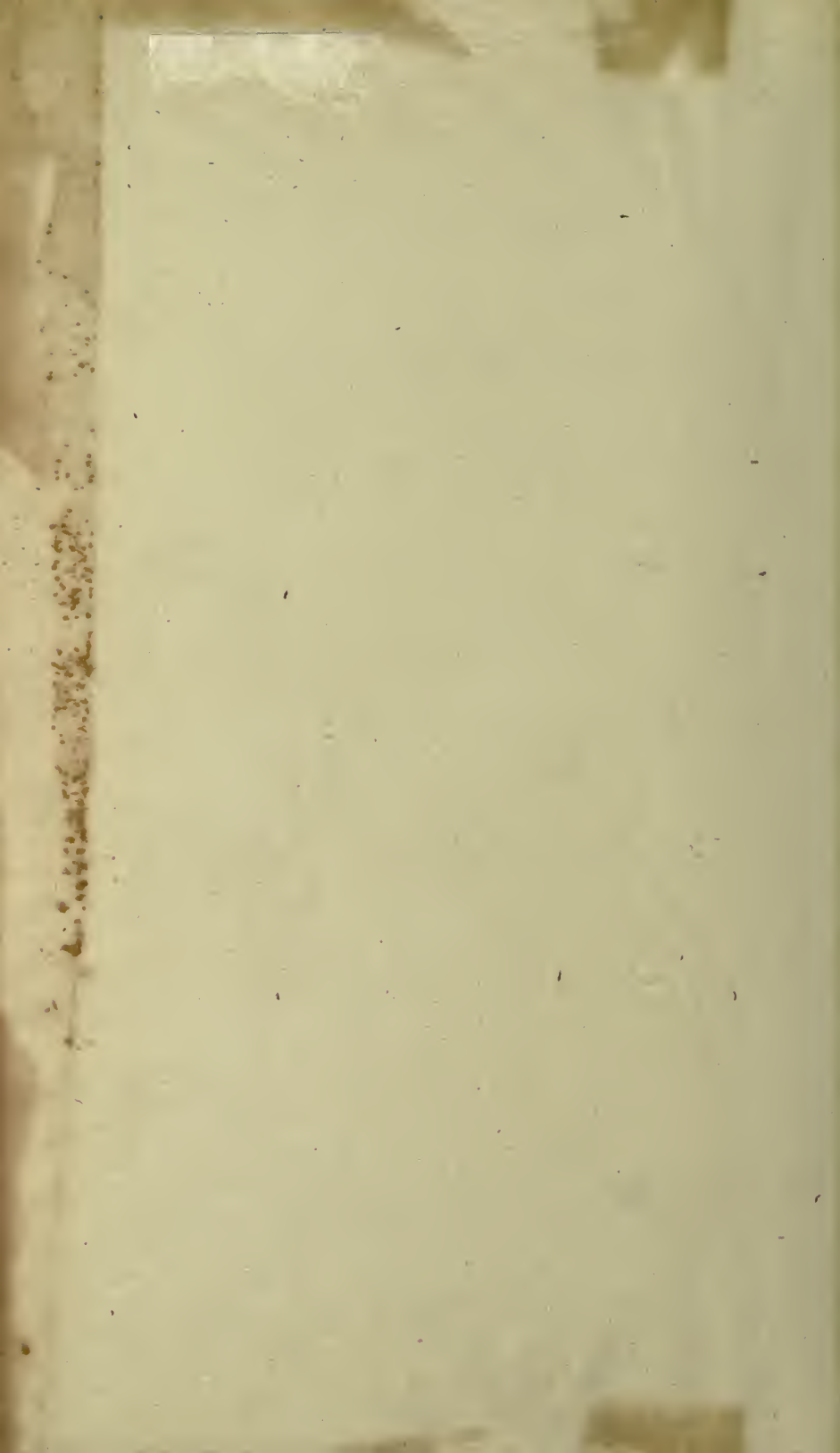
Species:

Nesophlox evelynæ (Bourcier).

Nesophlox lyrura (Gould).

Nesophlox bryantæ (Lawrence).





UNIVERSITY OF CALIFORNIA, SANTA CRUZ



3 2106 01433 2198

